BILITERACY EFFECTS ON PHONOLOGICAL AWARENESS, ORAL LANGUAGE PROFICIENCY AND READING SKILLS IN TAIWANESE MANDARIN-ENGLISH BILINGUAL CHILDREN

BY

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DISSERTATION

Submitted in partial fulfillment of the requirements
for the degree of Doctor of Philosophy in Speech and Hearing Science
in the Graduate College of the
University of Illinois at Urbana-Champaign, 2009

Urbana, Illinois

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Abstract

The present study examined the effect of learning to read a heritage language on Taiwanese Mandarin-English bilingual children's Chinese and English phonological awareness, Chinese and English oral language proficiency, and English reading skills. Participants were 40 Taiwanese Mandarin-English bilingual children and 20 English monolingual children in the U.S. Based on their performance on a Chinese character reading test, the bilingual participants were divided into two groups: the Chinese Beginning Reader and Chinese Nonreader groups. A single child categorized as a Chinese Advanced Reader also participated. Children received phonological awareness tasks, produced oral narrative samples from a wordless picture book, and took standardized English reading subtests. The bilingual participants received measures in both English and Chinese, whereas English monolingual children received only English measures. Additional demographic information was collected from a language background survey filled out by parents. Results of two MANOVAs indicated that the Chinese Beginning Reader group outperformed the Chinese Nonreader and English Monolingual groups on some phonological awareness measures and the English nonword reading test. In an oral narrative production task in English, the English Monolingual group produced a greater total number of words (TNW) and more different words (NDW) than the Chinese Nonreader group. Multiple regression analyses were conducted to determine whether bilingual children's Chinese character reading ability would still account for a unique amount of variance in certain outcome variables, independent of nonverbal IQ and other potential demographic or performance variables and to clarify the direction of causality for bilingual children's performance in the three domains. These results suggested that learning to read in a heritage language directly or indirectly enhances bilingual children's ability in phonological awareness and certain English reading skills. It also appears that greater oral language proficiency in Chinese promotes early reading in the heritage language. Advanced heritage reading may produce even larger gains. Practical implications of learning a heritage language in the U.S. are discussed.

To My Grandmother, 黃林碧心 *(Pi-Hsin HuangLin)*

Acknowledgements

A great many people have contributed to the completion of this dissertation. I would like to thank them all. First, I am deeply grateful to my advisor, Dr. Cynthia J. Johnson, for inspiring my interest in child language through her teaching. Throughout my graduate career, her guidance, support, and encouragement have kept me motivated and helped me grow as a researcher. Her persistence in producing the best quality of work is what I admire and hope to emulate. I also want to thank the members of my dissertation committee: Dr. Kiel Christianson, Dr. Laura Segebart DeThorne, Dr. Elizabeth A. L. Stine-Morrow, and Dr. David Quinto-Pozos. Each read my manuscript with great attention to detail and provided insightful feedback and comments. I am immensely appreciative of the time and energy they put into my dissertation.

I would like to express my sincere gratitude to the children and parents who participated in this study. This dissertation would not have been possible without their support. Their encouragement and friendly faces have made each data collection trip enjoyable and meaningful. I thank Frank Parng, President of the Midwest Chinese Language Schools Association, and several principals of the Chinese heritage schools in Ann Arbor, Champaign, and Chicago, for their generous assistance in recruiting bilingual participants. Special thanks go to the following principals: Chien-An Chen, Juhchin Yang, Ai-Ling Tsai, Judy Lee, Hual-Te Chien, and Chong-Fu Hsieh. Also, Erin Tarr, Associate Director of Next Generation School in Champaign, helped me recruit English-speaking participants. I particularly appreciate the many parents and Chinese school teachers who went the extra mile to find more participants for me. My heartfelt thanks go to Yu-Yuan Pan, who had just met me once before kindly offering me a place to stay while I collected data in Ann Arbor. During that period, I experienced the bitterly cold winter in

Michigan but received the warmest support from her entire family. I am also thankful to ShinFan Chang and her husband for making the data collection in Chicago possible.

I would like to express my appreciation to the following funding sources. The Ehud and Janie International Graduate Student Award contributed by Dr. and Mrs. Yairi supported data collection and analysis of the study. I am extremely grateful to Dr. and Mrs. Yairi for their kindness and encouragement. It is an honor to receive the award and a pleasure to have known such a gracious couple. The Graduate College Conference Travel Award from the Graduate College supported the presentation of the study to the 2009 American Speech-Language-Hearing Association (ASHA) convention. I also thank PRO-ED, Inc. for providing a complimentary copy of the Test of Nonverbal Intelligence-3 (TONI-3) and Pearson Education, Inc. for providing a copy of the Woodcock Reading Mastery Test-Revised (WRMT-R) and offering a discounted rate for the scoring sheets.

Special thanks must go to the following faculty and staff members in the department: Ms. Lisa Crane, for her assistance in recruiting participants; Dr. Pamela Hadley, for sharing valuable teaching experience and materials with me and providing helpful suggestions at my defense meeting; and Ms. Pat Hawkins, for her ready smile and wonderful help. I also thank a wonderful group of Ph.D. students in the department: WooJae Han, HeeCheong Chon, Huai-Rhin Kim, YiHe Zu, Panying Rong, Amie King, Christina Bronson-Lowe, and Seok-Youn Yoon. In addition, I am grateful to Jamie Smith for her help in recruiting participants, to Lynn Brault for her assistance in recording the English phonological awareness stimuli, and to Beth Greenburg and Kristen E. Sterna for transcribing language samples for reliability checks.

I am indebted to my parents, Jen-Hsiang Yang and Ying-Shun Huang, for giving me such a valuable opportunity to study abroad and always having a sweet home ready for me to return to during school breaks. Their constant support has been a great source of motivation. I also thank my sister, Fang-Ching Yang, and brother-in-law, Wen-Yang Chang, for their company in the U.S. I am grateful to my uncles and aunts in both Taiwan and California for the concern they have shown to me. Finally, but certainly not least, to Chi-Sheng Yu: I cannot thank him enough for being so patient with me over the years. His sense of humor and positive thinking helped me bear the pressure of many tough stages of pursuing this degree.

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Chapter One

Introduction

In the past three decades, the number of children who grow up learning more than one language has increased rapidly. In the U.S. alone, according to the most recent census, approximately 19% of the U.S. population speaks a language other than English at home (U.S. Bureau of the Census, 2007). Among this population, many are children who learn English as a second language. The increased number of bilingual children in school has led to a relatively new field of research: bilingual literacy acquisition. For several years, research in this area has focused on bilingual children's school achievement, comparing them with their monolingual peers on school-type measures in a second language (Macnamara, 1966, as cited in Bialystok, 2007). In recent years, much bilingual research has systematically investigated how the interaction between bilingual children's two languages may change the course of their literacy development in their second language. The ultimate goal of many studies was still to compare bilingual children with monolinguals and determine whether bilingualism is a positive or negative childhood experience for literacy acquisition in a second language. This approach has considered monolingual language learning experience as the norm. Nevertheless, bilingual children are likely to have different language developmental milestones. As suggested by Grosjean (1989), "the bilingual is not two monolinguals in one person" (p. 3). Therefore, due to a close relation between reading and language, when examining bilingual children's reading performance, it is also important to compare bilingual children with their bilingual peers who acquire languages under similar circumstances. Moreover, the predominant bilingual population being studied so far in the U.S. is Spanish-English bilingual children. As Chinese has become the second largest non-English speaking population in the U.S. (Shin & Bruno, 2003), there is a need to understand language and reading development in this group of children (Goldstein & Kohnert, 2005).

The present study sought to examine biliteracy effects on language and literacy abilities in Taiwanese Mandarin-English bilingual children. Bilingual children of different levels of Chinese reading ability were divided into three groups based on their Chinese reading ability. Because of a close relation between oral language and reading, bilingual children's phonological awareness and oral language proficiency were systematically examined. Also, bilingual children's English reading skills were measured to consider a potential relation between Chinese and English reading. Specifically, the following research questions were addressed:

1. Do Taiwanese Mandarin-English bilingual children's phonological awareness skills in both languages differ as a function of their level of Chinese reading ability?
2. Do bilingual children's oral language proficiency in both languages differ as a function of their level of Chinese reading ability?
3. Do bilingual children's English reading skills differ as a function of their level of Chinese reading ability?
4. Does each Mandarin-English bilingual subgroup differ from a monolingual English-speaking group in English phonological awareness, oral language proficiency, and reading skills?

Chapter Two

Review of Literature

Reading is an important skill in any educated society. The path to skilled reading begins before children receive any formal reading instruction in school. A number of different theoretical models have been developed to explain reading development (Chall, 1996; Ehri, 1991; Perfetti, 1992). Reading acquisition is tightly associated with language acquisition, because it shares many similar processes and knowledge bases such as speaking and listening (Catts & Kamhi, 2005). Therefore, we might expect that reading acquisition of bilingual children -- by virtue of speaking two languages -- may be different from that of monolingual children in certain ways. In this chapter, I will (a) introduce important stages of reading development and reading skills, (b) review studies regarding two of the most important underlying skills of reading, phonological awareness and oral language proficiency, and (c) survey current bilingual reading research in reading acquisition. At the end of this chapter, I will present a rationale that guides the present study, along with specific research questions and hypotheses.

Reading Acquisition

Learning to read English.

Stages of reading development. The model of reading development that Chall (1996) has proposed for English describes six important stages through which children need to pass, beginning with prereaders and ending with college-aged readers. In Stage 0 (6 months to kindergarten), children pretend to read and acquire important print concepts about what reading is all about. Children may recognize their names in print and some signs (e.g., *Stop* and *Coca-Cola*) from environmental print. The method of acquiring these skills is generally dependent on print exposure. In Stage 1 (Grade 1 to the beginning of Grade 2), children start to learn grapheme-phoneme correspondence rules, and are able to sound out single syllable words. Children also begin to read simple texts. In this stage, children rely on direct instruction, such as phonics, to acquire reading skills. In Stage 2 (Grades 2 to 3), children know about 3,000 words, and are able to read simple texts more fluently. One of the most important features of this stage is that children consolidate basic decoding skills and accumulate more sight vocabulary. Direct instruction of reading skills is still important in this stage. Stages 1 and 2 are characterized as "learning to read," in which the emphasis is on mastering decoding skills and recognizing words. Also, in these two stages, reading is initially dependent on oral language skills (Flood & Lapp, 1987, as cited in Catts & Kamhi, 2005). As children move beyond these two fundamental stages, they "read to learn." In other words, children use their reading ability to refine their learning process. In Stage 3 (Grades 4 to 9), children read to gain new knowledge. Acquisition of reading in this stage relies less on direct instruction. Instead, classroom discussion about texts or systematic study of words becomes more important. In Stage 4 (Grades 10 to 12), children read various texts that present diverse knowledge and perspectives. In Stage 5 (18 years or older), the process of decoding becomes highly automatized. Readers can read for self-defined purposes, and the goals of reading involve integrating knowledge from texts.

Word recognition skills in English. As noted earlier, children consolidate their basic decoding skills and develop more sight vocabulary in Stage 2 of learning to read English. Two important concepts are involved in this process: the alphabetic principle and automatic word recognition.

Alphabetic principle. Written words encode the sounds of spoken language (Catts & Kamhi, 2005). As children move into the stage of learning decoding skills, they have to develop alphabetic insight. Alphabetic insight refers to children's ability to read by processing sound-letter correspondences. Having this insight is just a starting point in learning decoding skills. The concept that sounds are associated with letters is rather abstract, because sound-letter correspondence is not always consistent. For example, the medial consonant in the words *writer* and *rider* are both pronounced as an alveolar flap /ɾ/ (Catts & Kamhi, 2005, p. 34). Nevertheless, the phoneme /ɾ/ is represented as *t* in *writer* and *d* in *ride* (Catts & Kamhi, 2005, p.34). Another example is that English spelling is rather irregular. For a single vowel sound /i/, there are several different spellings, such as *ie, e, ei, i, y, ea,* and *ee* (Catts & Kamhi, 2005, p. 35). As a result, the lack of one-on-one correspondence between sounds and letters in some alphabetic languages, such as English, makes learning to read a slow and difficult process. While recognizing and overcoming these obstacles, children gradually move beyond sounding out every word during reading, and begin to develop automatic word recognition skills.

Automatic word recognition. Several theorists mark the stage when children develop automatic word recognition skills as the orthographic stage (Catts & Kamhi, 2005; Ehri, 1991; Frith, 1985). This stage is characterized by children's use of letter sequences and spelling patterns to recognize unfamiliar words, without activating phonological information, but rather directly accessing meaning. This stage occurs after children have accumulated experience with phonologically decoding different words that share similar orthographic patterns. For example, the orthographic patterns that children usually detect include regularly spelled morphemes (e.g., -*ing, -ed, -able,* and *–ment*; Catts & Kamhi, 2005, p. 36) or words that share common orthographic neighborhoods (e.g., *-each* in *teach, preach,* and *reach*; Catts & Kamhi, 2005, p. 36). The storage of this information in memory allows children to use an analogy strategy to read new words and read words by sight without sounding out every single phoneme. The ability of automatic word recognition eventually makes reading a rapid and efficient process. Proficient word recognition skills thus enable children to allocate more attentional resources to text comprehension.

Reading comprehension. The ultimate goal of learning to decode words is to comprehend texts. Models of reading comprehension have often been divided into three categories: bottom-up, top-down, and interactive (Catts & Kamhi, 2005). Theorists of bottom-up models (Gough, 1972) view reading comprehension as a step-by-step process. Reading begins with processing visual input from the print and transforming the information through a series of stages, in which smaller units are integrated progressively into larger meaningful ones. General world knowledge or contextual information has little influence on the comprehension process. Theorists of top-down models (Goodman, 1970; Smith, 1971), in contrast, emphasize the importance of general world knowledge and contextual information from the passage being read. According to top-down models, reading involves making hypotheses about what will be read in the text, and revising or confirming initial hypotheses as information from the text is being processed. Readers depend on familiarity with the content or schemata rather than low-level perceptual information to construct meaning. Theorists of interactive models (Perfetti, 1985; Stanovich, 1985) consider both bottom-up and top-down processes contributing to reading comprehension. Therefore, proficient word recognition skills and a higher level of general knowledge and contextual information are equally important. While interpreting the text, readers need to draw upon both top-down and bottom-up information.

Learning to read Chinese.

Overview of Chinese characters. Chinese is a logographic writing system in which characters are the basic units of print. Characters correspond to both syllables and morphemes. The characters are composed of *radicals.* Some radicals can stand alone, and contain information about meaning and pronunciation, whereas some radicals cannot. For example, 馬 /ma3/ is a character which can stand alone and has its own meaning, *horse*. 馬 /ma3/ is also a phonetic radical which can represent the consonant-vowel syllable in other semantic-phonetic compound characters such as 媽 (mother) /ma1/. Some radicals do not encode meaning or pronunciation when not being combined with another radical. For example, 扌 means *hand* only when it is combined with another phonetic radical. Characters that contain more than one radical are called semantic-phonetic compound characters (also called "phonetic compounds" or merely "compounds"), which represent more than 80% of written Chinese characters (Shu, 2003). A semantic-phonetic compound character consists of a semantic radical and a phonetic radical. The semantic radical gives information about meaning of the entire compound character, whereas the phonetic radical provides full or partial information about pronunciation of the entire compound character. For example, in the character 媽 /ma1/ (meaning *mother*), 女 is the semantic radical which means *female*, whereas 馬 /ma3/ (meaning *horse*) is the phonetic radical which represents the sound of the whole character. The numerals indicate one of the Chinese tones. Chinese is a tonal language. A Chinese character with different tones represents different meanings. For example, in 媽 (mother) /ma1/ and 馬 (horse) /ma3/, "ma" represents a consonant-vowel syllable and the numerals "1" and "3" represent high and low tones (i.e., pitch), respectively. Although both characters share the same consonant-vowel syllable articulation, different tones make them have two distinct meanings. In Mandarin, there are a total of four different tones, whereas in Cantonese, there are nine.

The components in semantic-phonetic compound characters have fixed positions. Most of them have a left-right structure with the semantic radical on the left and the phonetic radical on the right (Shu, 2003). For example, 媽 (meaning *mother*) has the semantic radical 女 (meaning *female*) on the left and the phonetic radical 馬 (meaning *horse*) on the right. Some compound characters have top-bottom structures. In the top-bottom structure, the semantic radical or the phonetic radical is either on the top or on the bottom. For example, 花 (meaning *flower*) has the semantic radical 艹 (meaning *grass*) on the top and the phonetic radical 化 (meaning *transform*) on the bottom. A few rare types of compound characters have an inside-outside structure with the phonetic radical inside surrounded by the semantic radical outside. For example, 固 (meaning *solid*) has the phonetic radical 古 (meaning *old*) surrounded by the semantic radical, 口 (meaning *circle*).

In addition to semantic-phonetic compounds, Chinese characters also include pictographs, ideographs, semantic compounds, and a few other rare types (Shu, Chen, Anderson, Wu, & Xuan, 2003). Pictographs are simple characters that typically represent the shapes of real-life objects. For example, 日 was originally the character for *sun*. Pictographs, however, have evolved and they do not realistically and accurately represent the shapes of objects as they once did in Ancient Chinese. Instead, modern pictographs are abstract and symbolic representations of the shapes of objects. The other type of meaningful simple character is the ideograph. For example, 上 means *up* and 下 means *down*. In addition, there is a type of semantic compound in which both components in a character contribute to the meaning of the character. For example, the character 信 (meaning *letter*) is composed of the radical for *person* (人) and the radical for *words* (言). The combination of both denotes the meaning of the whole character. The three types just described, however, only represent a small percent of all Chinese characters (Taylor & Taylor, 1995). In the Chinese that school children encounter in print, the majority of characters are semantic-phonetic compounds (Shu, Chen, Anderson, Wu, & Xuan, 2003). Therefore, most of the research regarding how children apply cues in orthography focuses on semantic-phonetic compound characters.

The phonetic principle. Parallel to the alphabetic principle in English, the principle that governs script and sound correspondence in Chinese is called the "phonetic principle" (Anderson, Li, Ku, Shu, & Wu, 2003, p. 53). Just as acquiring the alphabetic principle is an important step toward proficient word recognition in English, developing an insight into the phonetic principle is also critical in Chinese reading acquisition. Research has shown that the phonetic radical in phonetic-semantic compound characters provides logical information about pronunciation in Chinese. Children are able to use this information to read unfamiliar characters (Anderson, Li, Ku, Shu, & Wu, 2003; Shu, Anderson, & Wu, 2000). Shu, Anderson, and Wu's (2000) study showed that Chinese children's insights into the phonetic principle continue to develop over the elementary school years.

In summary, both English and Chinese skilled word recognition require an insight into the print-sound correspondence in the writing system. In the next section, I will review studies on phonological awareness, an important underlying skill that contributes greatly to word-level reading ability across many different languages.

Phonological Awareness

Phonological awareness refers to the competence of analyzing and reflecting upon the sound structure in one's language (Goswami & Bryant, 1990). Phonological awareness skills are usually distinguished by the tasks that are used to measure them (e.g., an odd-man-out task and a sound blending task) and unit(s) of sound measured in the task (e.g., onset, rime, and phonemes). The units of sound typically measured in phonological awareness tasks are the syllable, onset and rime, and phoneme. *Onset* refers to the initial consonant or consonant cluster in a word, whereas *rime* contains the remaining vowel and consonants. For example, in the word *clam*, *cl* is the onset; *am* is the rime; and /k/, /l/, /æ/, and /m/ are the phonemes. There are a variety of tasks that have been used to measure phonological awareness, such as blending (e.g., "What does /k/ /ɑ/ /r/ say?"), deletion (e.g., "Say *Sunday* without *sun*"), and oddity tasks (e.g., "Which word starts with a different sound: *rug, rope, can, red?*") (Anthony & Francis, 2005).

The linguistic status hypothesis proposed by Treiman (1992) predicts that children first acquire the ability to segment speech into larger unit (e.g., words) before they are able to segment speech into smaller units (e.g., syllable, intrasyllabic units, and phonemes). More specifically, the component phonemes in a syllable are structured hierarchically, such that the syllable is a larger unit than the onset-rime, which in turn is larger than individual phonemes (Treiman, 1985; Treiman, Mullennix, Bijeljac-Babic, & Richmond-Welty, 1995). Research has shown that the development of phonological awareness also follows this sequence. In other words, children generally develop syllabic awareness before they develop onset-rime awareness, and onset-rime awareness before phoneme awareness (Anthony et al., 2002). Syllable awareness is usually fully developed by kindergarten. It is also suggested that phoneme awareness only develops after children begin to read (Treiman & Zukowski, 1996). This position is supported by research comparing illiterate and literate adults on phonemic awareness tasks. Illiterate adults have been found to lack phonemic awareness skills (Bertelson, de Gelder, Tfouni, & Morais, 1989).

It is important to note that phonological awareness is different from two other phonological processing skills. Wagner and Torgesen (1987) identify three bodies of phonological processing research. Three kinds of phonological processing include: (a) *phonological recoding in lexical access*, which means the process of recoding a written symbol into a sound-based code for access to its meaning, (b) *phonetic recoding in working memory*, which refers to recoding a written symbol into a sound-based code and remembering this sound representation, and (c) *phonological awareness*, as previously defined. A typical task for *phonological recoding in lexical access* is judging whether a letter combination is a real word or a pseudoword. A common task used to assess *phonetic recoding in working memory* involves decoding several sets of letters and holding the corresponding sets of sounds in memory. This skill is essential when the reader needs to blend the sounds together to form words.

Phonological awareness as an early indicator of later word reading ability in monolingual English-speaking children. Among the three phonological processing skills, phonological awareness is the one most related to literacy. This strong association has been reported in a large body of research (for reviews, see Adams, 1990; Goswami & Bryant, 1990). In particular, children's phonological awareness in kindergarten has been shown to provide predictive information for the reading ability in the early grades. Furthermore, research has shown that poor phonological awareness in kindergarten can predict the presence of reading disability in second grade (Catts, Fey, Zhang, & Tomblin, 2001; Catts, Fey, Tomblin, & Zhang, 2002).

Wagner, Torgesen, and Rashotte (1994) investigated the nature of phonological processing skills and their relation to later word decoding ability in a 3-year longitudinal study of children from kindergarten through second grade (n = 244). The children were tested on a battery of phonological, word-level reading (Woodcock, 1987), and vocabulary tasks in the fall of kindergarten, first-grade, and second-grade. The three assessment points permitted further investigation of causal relations. Phonological processing skills were measured through three types of subtests: phonological awareness, phonetic recoding in working memory, and phonological code-naming tasks. The first two types were defined in the preceding section. The last type, phonological code naming tasks, involves the ability to retrieve sounds of letters or words stored in long-term memory. In their latent variable modeling, the estimates of the correlations of each phonological processing skill with itself across three time intervals (i.e., kindergarten to first grade, first grade to second grade, and kindergarten to second grade) were statistically significant, which indicated that the phonological processing skills develop stably from kindergarten through second grade. Also, one of the phonological awareness skills (as measured by phonological analysis tasks) in kindergarten revealed strong causal influence on word-level decoding in first grade. Another phonological awareness skills (as measured by phonological synthesis tasks) in first grade showed causal influence on word-level decoding in second grade. In terms of the causal influence of reading ability on phonological awareness, the latent variable modeling revealed that kindergarten letter-name knowledge had a causal influence on first grade phonological awareness skills. In sum, the authors concluded that there was a bidirectional relation between phonological processing and reading skills: Better phonological processing skills in kindergarten and first grade led to better decoding ability in first and second grade, respectively; conversely, better letter naming knowledge in kindergarten led to better phonological processing skills in first grade.

The same group of children (n = 216, as a result of 28 children from the previous study who did not continue) in Wagner, Torgesen, and Rashotte (1994) were followed until fourth grade. Results of the changing relations between phonological processing skills and word-level reading ability were reported (Wagner et al., 1997). The same tasks were administered to the child in the fall of third and fourth grades. Results suggested that the predictive power of phonological awareness for later word-level reading ability extends through fourth grade; however, the variance accounted for by word-level reading decreased from 23% in kindergarten through second grade to 4% in second through fourth grade. Unlike phonological awareness, the predictive power of phonological code naming and vocabulary disappeared by second to fourth grade. The bidirectional relation between phonological awareness and reading-related skills remained evident in that letter naming knowledge was predictive of subsequent phonological awareness skills. This study demonstrates that phonological awareness can provide predictive information about children's word-level reading until fourth grade, but the variance that it can account for decreases year by year as other control variables (e.g., the increasing autoregressive effect of word-level reading in earlier grades on word-level reading in later grades)increased. In other words, more of the variance of children's word-level reading ability in later grades was accounted for by prior word-level reading ability than by prior phonological awareness skills.

Extending the results of the previous two studies, Lonigan, Burgess, and Anthony's (2000) longitudinal study demonstrated that phonological awareness was a robust predictor of later reading ability when compared with other emergent literacy skills. Participants were two groups of preschool children; a younger group (n = 96, *M* = 41.02 months) and an older group (n = 97, *M* = 60.04 months). The younger group completed follow-up tests 18 months after the initial testing time, whereas the older group received follow-up tests 12 months after the initial testing time. This schedule represents children's development of the target skills at four different time periods: early preschool, late preschool, kindergarten, and first grade. The children were tested on three skills considered to be reliable predictors of preschool emergent literacy skills: oral language, print knowledge, and phonological awareness. The phonological awareness measures included an onset oddity task; a rime oddity task; a syllable or phoneme blending task;

and a syllable or phoneme deletion task. The purpose of the study was to examine the nature of these three emergent literacy skills and their relation to children's later reading ability. The results revealed that children's phonological awareness ability continuously progresses from early preschool to first grade. Moreover, phonological awareness and letter knowledge were shown to be the only two significant predictors, which accounted for 54% of word decoding skills in first grade.

In sum, the aforementioned longitudinal studies have suggested that children's phonological awareness ability is predictive of their word-level reading ability. In particular, starting from the early preschool years until second grade, children's phonological awareness ability can be used as a useful indicator of their later decoding ability. It is worth noting that as children begin learning to read; prior word-level reading ability is predictive of their subsequent phonological awareness. The relation between phonological awareness and word-level reading becomes bidirectional after children receive reading instruction.

Reciprocal relation between phonological awareness and reading. Using path analysis, Hogan, Catts, and Little (2005) examined the relation between phonological awareness and reading in the same group of children from kindergarten to fourth grade. The participants (n = 570) were a subsample of children from an epidemiologic study of language impairment (Tomblin, 1995). Due to a higher prevalence of children with language impairment in this sample than in the general population, a weighting scoring procedure was employed to ensure that the results were representative of the original sample. Each child received tests at three different points: kindergarten, second grade, and fourth grade. In kindergarten, each child was administered a test of phonological awareness and a letter identification subtest of the Woodcock Reading Mastery Tests-Revised (WRMT-R, Woodcock, 1987). In second and fourth grades, each child was given phonological awareness tests, and subtests of real word and pseudoword reading from the WRMT-R. A phoneme/syllable deletion test (Catts et al., 2001) was used to measure children's phonological awareness ability. The results indicated that phonological awareness in kindergarten predicted second-grade real word and pesudoword reading. The most striking finding was that phonological awareness in second grade no longer predicted fourth-grade real-word reading. Instead, fourth-grade real word reading was predicted by second-grade real-word reading. Evidence that reading influences phonological awareness is shown in the results that second-grade real-word and pseudoword reading predicted fourth grade phonological awareness.

McGuinness, McGuinness, and Donohue (1995) investigated whether explicit training in English phonology improves children's phonological awareness and reading outcomes. The method of explicit instruction in English phonology used in the study is called Auditory Discrimination in Depth (ADD; Lindamood & Lindamood, 1975). ADD was originally designed for children with reading difficulties in clinical settings. The essence of the method is to allow children to discover English phonemes and teach them to connect sounds to print. This method is different from phonics, which teaches from print to sounds. Participants were first graders enrolled in two private schools and came mainly from high SES families. There were two experimental groups (one of them attended a Montessori school) and one control group. One of the experimental groups and the control group came from the same school. The teachers of the two experimental groups were trained in the ADD program. The control group used a modified whole language plus phonics approach. At the beginning and the end of the school year, the children were tested on a battery of tests which measured their phonological awareness, and real word and pseudoword reading ability. Results showed that both experimental groups performed better than the control group on real word and pseudoword reading ability. Unexpectedly, the experimental groups did not outperform the control group on the phonological awareness tasks after the ADD training. All three groups achieved higher scores on phonological awareness tasks at the end of first grade. From this result the authors concluded that phonological awareness facilitates learning to read, regardless of the reading instruction method used.

To summarize, children's phonological awareness appears to increase as they accumulate experience in learning to read (McGuinness et al., 1995). Nevertheless, the aforementioned studies did not explicitly explain how reading experience may increase children's phonological awareness. Also, if reading experience contributes to the development of phonological awareness, good readers and poor readers should perform differently on phonological awareness tasks.

In a recent study, Ziegler and Muneaux (2007) investigated how literacy experience affects spoken word recognition. Specifically, they aimed to examine the effects of reading experience on spoken word recognition. They predicted that phonological neighborhood density, which refers to the number of words that differ from a target one by one phoneme, would have inhibitory effects on spoken word recognition, whereas orthographic neighborhood, which refers to the number of words that differ from a target word by one letter, would have facilitatory effects. In other words, people would find it more difficult to recognize words in dense phonological neighborhoods (e.g., *sat* has many phonological rime neighbors such as *hat, rat, cat, pat*) than those in sparse neighborhoods. On the other hand, people would recognize spoken words with many orthographic neighbors (e.g., *wipe*) more quickly than those with few orthographic neighbors (e.g., *type*). Participants were three groups of monolingual French children learning to read French: beginning readers (n = 18, *M* age = 7; 1), advanced readers (n = 18, *M* age = 11; 4), and children with dyslexia (n = 18, *M* age = 11; 4). The advanced readers and children with dyslexia were matched for chronological age. Children's reading ability was assessed by a standardized reading test. The authors predicted that both beginning and advanced readers would show inhibitory phonological neighborhood effects. Only advanced readers would show facilitatory orthographic neighborhood effects. Each child was given a spoken lexical decision task, in which he or she was asked to indicate as quickly and as accurately as possible whether the spoken stimulus was a real French word. Stimuli of dense and sparse phonological and orthographic neighborhoods were designed, resulting in four different conditions. The results confirmed the authors' hypotheses. Reading expertise significantly predicted the orthographic neighborhood effects but not the phonological neighborhood effects. This study provided evidence that orthographic effects on spoken word recognition differ as a function of children's literacy expertise.

To conclude, the studies reviewed in this section suggest that reading development is initially affected by phonological awareness. This relation seems to reverse when reading is underway; phonological awareness is then affected by reading experience and expertise. In the next section, I will review studies regarding the development of phonological awareness across languages and particularly in Mandarin-speaking children.

Phonological awareness and reading ability in Mandarin monolingual children.

Language and writing systems in Taiwan, Hong Kong, and Mainland China. People who learn to read Chinese speak a variety of more or less closely related languages in different regions. For example, Mandarin is the official language spoken in Mainland China and Taiwan, whereas Cantonese is the official language spoken in Hong Kong. Therefore, to differentiate spoken language from the writing system, I will use *Chinese* to refer to the print system and *Mandarin* or *Cantonese* to refer to spoken language. Reading or phonological awareness studies of Mandarin-speaking children mainly come from three different regions: Taiwan, Hong Kong, and Mainland China. Each region differs in terms of Chinese characters, official spoken language, and literacy instruction. It is important to keep these differences in mind when we interpret research results. I will briefly describe the differences before reviewing these studies. Table 1 is a summary of these differences. In Taiwan and Hong Kong, children learn full traditional Chinese characters, whereas in mainland China, children learn simplified Chinese characters. Simplified characters were created by reducing the number of strokes in order to lessen the burden of learning to write Chinese characters. In addition, children in Taiwan, Hong Kong, and mainland China speak different but more or less closely related Sino-Tibetan languages. In Taiwan and mainland China, children speak Mandarin which is mutually unintelligible with Cantonese spoken in Hong Kong. The three regions also differ in their literacy instruction. Children in Taiwan learn Zhu-Yin-Fu-Hao, a phonetic bridge system in which a subsyllabic segment of a character's pronunciation is represented by a unique symbol. There are a total of 37 Zhu-Yin-Fu-Hao symbols to represent Mandarin sounds: 21 consonants and 16 vowels. Zhu-Yin-Fu-Hao is taught in order to help children form associations between visual characters and speech sounds. Children learn this phonetic bridge system in the first 10 weeks of instruction in first grade. Instead of Zhu-Yin-Fu-Hao, however, children in mainland China are taught to use Pinyin as a phonetic script. Pinyin is a phonemic representation system, which is represented by Roman letters. The function of Pinyin is similar to that of Zhu-Yin-Fu-Hao. In contrast to Taiwan and mainland China, in Hong Kong, most children learn to read Chinese characters without learning a phonetic bridge system. Therefore, most of children in Hong Kong have to learn characters by rote memory.

The relation between characters and sounds in Chinese is considered to be opaque compared with other writing systems. In addition to English, the importance of phonological awareness in children's reading acquisition is well established for other alphabetic languages such as Spanish (Denton, Hasbrouck, Weaver, & Riccio, 2000), Italian (Cossu, Shankweiler, Liberman, Katz, & Tola, 1988), and French (Demont & Gombert, 1996). Nevertheless, in the past decade, a growing body of research has shown that phonological awareness also plays an important role in Chinese children's early reading (e.g., Ho & Bryant, 1997; Hu & Catts, 1998; Huang & Hanley, 1997; Siok & Fletcher, 2001).

In a longitudinal study, Huang and Hanley (1997) investigated the relation between early phonological awareness skills and later Chinese character reading ability in 40 Taiwanese children. The children were in first grade (M = 6.48 years) and were tested at three different points in time: before they had learned Zhu-Yin-Fu-Hao, right after they had learned Zhu-Yin-Fu-Hao, and at the end of first grade. Each child received a set of phonological awareness tasks, a Chinese character reading test, a visual paired-associates learning test, and a vocabulary and IQ test. The phonological awareness tasks included a phoneme deletion task and an onset/rime/nucleus oddity task in which items were real words and pseudowords. The results showed that children's performance on the phonological awareness tasks at the first testing time was significantly correlated with their Chinese character reading ability at the end of first grade. In contrast, early performance on the visual paired-associates learning test was not related to later Chinese character reading ability. Children's phonological awareness skills also significantly improved after they learned to read. In particular, they made enormous progress from the first to the second testing time. The authors concluded that learning a phonetic bridge can increase children's phonological awareness even though instruction with the phonetic bridge system did not directly teach phonological awareness.

In line with Huang and Hanley's work (1997), Hu and Catts (1998) further demonstrated that children's early phonological processing skills in first grade predicted their Chinese character reading ability at the end of first grade. Participants (n = 50; *M* age = 6; 10) were first graders in Taiwan. They were tested three months after the school year started. Each child was given three phonological processing tasks, a visual memory task, a Zhu-Yin-Fu-Hao reading task, and a Chinese character reading test. The three phonological processing tasks included a phonological memory task, a phonological awareness oddity task, and a phonological retrieval task. The results showed that children's performance on the visual memory task did not correlate with their reading ability. Nevertheless, all three phonological processing skills were related to children's Chinese character and Zhu-Yin-Fu-Hao reading ability. Furthermore, scores on the phonological processing tasks accounted for a significant amount of variance in Chinese character reading ability. The authors concluded that the relation between phonological awareness and children's reading ability can be extended to a logographic writing system such as Chinese.

In conclusion, even though Chinese is a logographic writing system, the relation between phonological awareness and children's early reading ability is similar to that in alphabetic languages. Learning a phonetic bridge system such as Zhu-Yin-Fu-Hao seems to facilitate the development of children's phonological awareness as demonstrated in Huang and Hanley's study (1997).

Phonological awareness across languages. The studies reviewed in the previous sections have suggested that phonological awareness and early reading ability in children are highly correlated in both alphabetic and logographic print systems. Related to this issue, another line of research specifically examines how children learning different orthographies or speaking different languages may develop phonological awareness differently.

Building on the linguistic status hypothesis mentioned earlier (Treiman 1985; Treiman et al., 1995), Cheung, Chen, Lai, Wong, and Hills (2001) investigated whether early experience with the phonology of spoken language and the orthography of the written script would contribute to children's development of phonological awareness. Participants were three groups of children from different linguistic backgrounds. The authors did not provide information regarding whether participants in the three groups were comparable in IQ, age, and socioeconomic status. Participants from New Zealand spoke English and learned to read an alphabetic writing system. Participants from both Hong Kong and Guangzhou (China) spoke Cantonese and learned to read a logographic writing system, but participants from Guangzhou (China) had learned Chinese via the aid of Pinyin. Each linguistic group was further divided into a younger pre-reading group and an older sub-reading group. Specific grouping criteria were not described in the study, but the differentiation between these two reading groups was confirmed by later analyses of children's distinct character/word reading skills. With a maximum score of 30, mean reading scores for the Hong Kong, Guangzhou, and New Zealand younger pre-reading groups were 2.1 (SD 2.2), 1.4 (SD 2.9), 3.2 (SD 4.1), respectively. Mean scores for the Hong Kong, Guangzhou, and New Zealand older sub-reading groups were 26.8 (SD 1.7), 20.0 (SD 5.1), 16.7 (SD 6.2), respectively. No statistical analyses were conducted to confirm that the three younger pre-reading groups' reading scores were significantly lower than the three older sub-reading groups' reading scores. Nevertheless, it is important to keep in mind that *t*-tests showed that the differences among the three sub-reading groups were significant, which indicated that there were some discrepancies in reading ability among the three sub-reading groups. A sound-matching task was used to measure children's phonological awareness ability. The child was asked to decide which one of two probe words had the same syllable/onset/rime/coda as a target word. The children were tested in their native languages. There were three significant findings. First, the pre-reading groups from Hong Kong and Guangzhou performed similarly on all levels of phonological awareness tasks. When the scores of these two groups were combined and compared with those of the pre-reading group from New Zealand, the group from New Zealand was found to have better onset, rime, and coda awareness. The authors concluded that spoken language experience influences children's development of phonological awareness. In terms of the effect of orthographic experience, the sub-reading group from Guangzhou, who learned the phonetic bridge system, outperformed their counterparts from Hong Kong, who only learned Chinese characters by rote. This finding suggests that experience with an alphabetic script significantly influences children's phonological awareness. The authors concluded that experience with both phonology and orthography of a language seems to have an impact on the development of phonological awareness.

Cheung et al.'s (2001) study suggested that English speakers develop more advanced phonemic awareness. The reason was attributed to the fact that English contains more consonant clusters. Learning to read or processing spoken English would require children to pay attention to small phonological units such as phonemes. Therefore, people who learn to read and speak an alphabetic language such as English might have more direct access to phonemic awareness. In a later study, McBride-Chang, Bialystok, Chong, and Li (2004) specifically investigated whether Chinese-speaking children would be more sensitive to the syllable structure since Chinese characters are represented at the syllabic level. Participants were children in kindergarten and first grade from Xian (China), Hong Kong, and Toronto. Differences in literacy experiences among the three groups of children were similar to those described in Cheung et al.'s (2001) study. Different from Cheung et al.'s (2001) study, children from Xian (China) spoke Mandarin. Additionally, a subgroup of children who were learning English as a second language was recruited from Xian (China), and a subgroup of Mandarin-English bilingual children were recruited from Toronto. The group from Hong Kong was learning both English and Chinese. There were a total of five groups. The author did not provide information of how the groups compared in age, IQ, and socioeconomic status. Each child was tested individually on English word recognition, Chinese character recognition, syllable deletion in both languages, and phoneme onset deletion in both languages. The results showed that both literacy instruction and spoken language significantly influenced children's development of phonological awareness. Children from China, who used a phonetic bridge system, developed more advanced Chinese and English phonemic awareness than their peers from Hong Kong. This could be attributed to the fact that a phonetic bridge system promotes children's phonemic awareness. In terms of the effects of spoken language, children from Hong Kong and China performed equally well or better on the English syllable deletion task compared to their counterparts from Toronto. This result suggested that the representation of Chinese characters at the syllable level appeared to aide Chinese-speaking children's syllable awareness. Moreover, hierarchical regression analyses demonstrated that Chinese syllable awareness predicted Chinese character recognition, whereas English phoneme awareness predicted English word recognition. This study underscores the importance of oral language and writing systems in the development of phonological awareness.

In summary, the two aforementioned studies show that children from different linguistic backgrounds vary in phonological awareness across three phonological units (i.e., syllable, onset/rime, and phoneme). Most importantly, these cross-linguistic comparisons further refine the relation between phonological awareness and reading. Specifically, phonological awareness does correlate with word-level reading, but it appears that phonological units that are more relevant for reading of a given print system are more likely to significantly interact with word-level reading than are other less relevant ones. This concept seems to correspond to the psycholinguistic grain size theory proposed by Ziegler and Goswami (2005, 2006) discussed as follows.

Psycholinguistic grain size theory. In an attempt to integrate cross-linguistic research on reading acquisition and dyslexia into a theoretical framework, Ziegler and Goswami (2005, 2006) proposed a psycholinguistic grain size theory. They reviewed a large body of cross-linguistic studies on phonological development, reading development, and dyslexia. According to this theory, phonological processing plays a fundamental role in reading acquisition. It is important to understand phonological development when studying reading. The theory proposes that the degree to which spoken language maps onto written language varies across languages. For example, the print-sound relationship in some alphabetic languages such as Spanish and Italian is more consistent than others such as English. Therefore, children's differences in reading efficiency across languages depend on the ease or difficulty of recoding phonology in print. The concept of psycholinguistic grain size is similar to the three phonological units described earlier, in which phonemes represent smaller grain size than onsets or rimes, which in turn are smaller than syllables. Learning to read more consistent languages requires recoding small grain sizes, whereas learning to read inconsistent languages involves small and large grain sizes. These differences across languages result in developmental "footprints" in reading (Ziegler & Goswami, 2005, p.3). In other words, the characteristics of languages in terms of orthography and phonology would lead to different developmental paths to skilled reading.

Psycholinguistic grain size theory (Ziegler & Goswami, 2005, 2006) has been developed based on reading research mostly in alphabetic languages. In examining its application to Chinese reading, McBride-Chang et al. (2008) provided empirical evidence showing that tone is an important psycholinguistic unit for reading Chinese. They investigated how three psycholinguistic units (syllable, onset, and tone) were related to word-level reading in Chinese and English in the same children. Participants ($n = 211$) were Chinese children from Hong Kong, who were native speakers of Cantonese at age 4 or 5, and started learning English at age 3 at school. Each child was tested on a battery of tests. The tests relevant to the discussion here were Chinese character reading, English word reading, tone awareness, syllable deletion, and onset deletion tasks. The results from separate regression equations revealed that syllable deletion equally predicted Chinese and English word-level reading. It is worth noting that tone awareness predicted a significant amount of the variance in Chinese character reading, whereas onset deletion was predictive for English word reading. These findings indicate that larger grain size units are more important than smaller ones in Chinese reading. Also, the authors suggested that tone represents one of the fundamental psycholinguistic units of Chinese character reading. This result should help refine psycholinguistic grain size theory.

Phonological awareness in bilingual children. Phonological awareness ability in bilingual children has been examined through two lines of research. One compares bilingual children with their monolingual peers and investigates whether being bilingual accelerates phonological awareness. The other line of research focuses on cross-linguistic transfer effects of phonological awareness. Specifically, bilingual children’s phonological awareness and reading skills in both languages are assessed in the same children. Correlation or regression analyses are used to determine how skills in one language are associated with those in the other language. I will review studies that represent these two lines of research in the following.

Comparison between Monolinguals and Bilinguals: Is There a Bilingual Advantage?

Bruck and Genesee (1995) conducted a study with two groups of children whose primary language at home was English. One group attended French immersion schools (bilingual group), whereas the other group attended English schools (monolingual group). The authors did not specify the location where the study was conducted. The data obtained from the parent questionnaires showed that the two groups had the same mean age (5; 9). The two groups were comparable in overall verbal ability and IQ. Nevertheless, maternal education in the bilingual group was higher than that in the monolingual group. Also, parents of the bilingual group read to their children in French more often than did parents of the monolingual group. All children were non-readers in kindergarten. Children were tested in kindergarten and in Grade 1. The children were given a set of English phonological awareness tasks, which measured their syllable, onset-rime, and phonemic awareness. English nonwords were used in all items to reduce any lexical effects. The results indicated that bilingual children outperformed their monolingual peers on onset-rime segmentation tasks in kindergarten, but that this effect disappeared by Grade 1. Both groups performed similarly on the other tests. A different pattern was observed in Grade 1. The bilingual group scored higher on syllable awareness tasks, whereas the monolingual group attained higher scores on phoneme awareness tasks. The authors attributed the heightened skills of syllable awareness to the saliency of the French syllable. Unlike English, each French word does not have a stressed syllable so all syllables are pronounced at the same intensity. As a result, it is easier for children to detect the syllable structure in French. The authors argued that once children detect the salience of syllable in French, their syllable awareness in English will thus be accelerated. The monolingual children's advantage on phoneme awareness was attributed to their experience of learning to read English in Grade 1. Therefore, the results showed that both literacy instruction and exposure to a second language can influence the pattern of children's development of phonological awareness.

Campbell and Sais (1995) investigated bilingual children's metalinguistic awareness skills in kindergarten. Both monolingual (n = 15; *M* age = 57.47 months) and bilingual children (n = 15; *M* age = 55.13 months) spoke English at home but the bilingual group used English and Italian at school. Except for the language used at school, the two groups received similar school instruction. The author reported that participants were recruited from two comparable London schools in which children were possibly matched on socioeconomic status and ethnicity. It was unclear whether the two groups were comparable in IQ. Each child was given a metalinguistic awareness test battery including semantic, morphological, and phonological awareness tasks. Phonological awareness tasks included an initial phoneme odd-one-out task and a syllable deletion task with nonsense words. All tasks were in English. The results showed that the bilingual children were better on phonological awareness tasks even though they were not fluent in Italian and the school was not designed to teach Italian as a second language. Their accelerated development of phonological awareness might be explained by exposure to Italian which has a more regular syllabic structure than that in English. Both aforementioned studies (Bruck & Genesee, 1995; Campbell & Sais, 1995) reported a bilingual advantage in phonological awareness for children who spoke two distinct alphabetic languages (i.e., French vs. English and Italian vs. English).

The positive effect of bilingualism on the development of phonological awareness was also observed in bilingual children whose L1 and L2 were two more or less closely related Sino-Tibetan languages. Chen et al. (2004) examined bilingual and monolingual Chinese children's development of phonological awareness. Bilingual children spoke both Cantonese and Mandarin, whereas monolingual children spoke only Mandarin. Participants were in first, second, and fourth grade. All participants came from working-class families. The two groups were comparable in maternal and paternal education. IQ was the covariate in analyses. Both groups of children received a set of phonological awareness oddity tasks, including tone, onset, and rime awareness. All tasks were presented in Mandarin. The stimuli were composed of real words and pseudowords. The results revealed that in first grade the bilingual children scored higher than their monolingual peers on tone awareness tasks for words that share Mandarin and Cantonese syllables, however, this effect disappeared by fourth grade. The bilingual advantage on tone awareness was attributed to the fact that Cantonese has more tones than Mandarin. Furthermore, the bilingual children outperformed their monolingual counterparts on onset awareness tasks in second grade. The authors explained that this advantage arose as the bilingual children began to gain more advanced proficiency in both languages in second grade. Nevertheless, again, this advantage was not observed by fourth grade. In summary, two factors might have contributed to the bilingual advantage observed in this study: bilingualism and the phonological structure of Cantonese.

On the other hand, neutral bilingual effects on phonological awareness were reported in some studies (e.g., Bialystok, Majumder, & Martin, 2003; Chiappe & Siegel, 1999). Bialystok, Majumder, and Martin (2003) conducted three studies with one group of monolingual English-speaking and three groups of bilingual children. In Study 1 and 2, the bilingual group was

French-English bilinguals who attended French schools and were fluent in both French and English. In Study 3, the bilingual children were Spanish-English and Chinese-English (half Cantonese speaking and half Mandarin speaking) speakers. All participants were recruited from middle-class suburbs. The authors did not report whether the groups were matched on IQ. The phonological awareness tasks were all in English, including a phoneme counting and a phoneme substitution task. It was found that the Spanish-English bilinguals outperformed monolingual English-speaking children on the phoneme segmentation task. In contrast, the Chinese-English bilinguals performed worse than the monolingual English group and the Spanish-English group. No performance difference was found between the French-English bilingual group and the monolingual English group. The Spanish-English advantage was attributed to the similarity of Spanish and English sound structures. The authors suggested that another possibility was that Spanish has a simpler phonetic structure, which may be transferred to English when children learn to read. Unlike Spanish, the phonological structure of Chinese is more distant from English. This study suggests that learning two specific languages (Spanish and English) may be an advantage, but bilingualism itself may not necessarily result in a bilingual advantage for phonological awareness.

To summarize, as suggested in Bialystok's (2002, 2007) research framework for bilingual reading acquisition, being bilingual does not necessarily lead to an advantage in phonological awareness. The reported bilingual advantages on phonological awareness seem to result from learning two languages of similar phonological structure or one with a simple phonetic structure and also depend on what level of analyses is being evaluated (Bruck & Genesee, 1995; Campbell & Sais, 1995; Chen et al., 2004). These studies suggest the importance of taking into consideration the phonological structure of the two languages when discussing potential bilingual effects on phonological awareness.

Cross-linguistic transfer effects of phonological awareness between two alphabetic languages. D'Angiulli, Siegel, and Serra (2001) reported positive cross-linguistic effects between Italian and English phonological skills. The participants were Italian-English bilinguals, English-speaking monolinguals, and Italian-speaking monolinguals. The Italian-English bilinguals, English-speaking monolinguals were born and lived in Canada, whereas the Italian-speaking monolinguals were recruited from Italy. The three groups of children were matched on chronological age and their family's socioeconomic status. The authors did not mention whether the three groups were comparable in IQ. Children's phonological processing skills were assessed by a series of English and Italian word reading and spelling tests. The results showed that there were significant intercorrelations between English and Italian phonological processing skills. This study suggests the interdependence of phonological processing skills in English and Italian. Also, the results indicated that bilingual children performed significantly better than monolingual English-speaking children on all English tests but worse than monolingual Italian-speaking children on Italian tests. The authors concluded that exposure to a second language with more predictable grapheme-phoneme correspondences (Italian) may facilitate phonological processing skills in English. This result is in line with Campbell and Sais's (1995) argument that exposure to a more regular Italian syllabic structure can enhance bilingual children's syllable awareness in English.

Durgunoglu, Nagy, and Hancin-Bhatt (1993) provided evidence of cross-language transfer of phonological awareness and word-level reading ability between Spanish and English. They examined English and Spanish word identification skills and Spanish phonological awareness abilities in Spanish-speaking beginning readers. Participants were reported to have limited English proficiency. Multiple regression analyses showed that Spanish phonological awareness ability and Spanish word identification skills predicted English word identification skills. This study suggests that the phonological awareness skills in children's first language can facilitate the process of learning to read in a second language, at least in the beginning stages.

Comeau, Cormier, Grandmaison, and Lacroix (1999) also reported a positive cross-language effect between two alphabetic languages: French and English. They conducted a one-year longitudinal study in English-speaking children enrolled in French immersion programs. The children were tested on word decoding and phonological awareness skills in both English and French. They found that children's phonological awareness skills in French and English were strongly related, which suggests the cross-language transfer of phonological awareness abilities.

To conclude, phonological awareness in two alphabetic languages is strongly correlated even during early stages when these skills are still developing (i.e., preschool and kindergarten). Furthermore, phonological awareness in bilingual children's first language seems to be a reliable predictor of second language word-level reading ability. In the next section, I will review studies that examined this relation in Mandarin-English bilingual children. It appears that research on the relation between phonological awareness and word-level reading in Mandarin-English bilingual children report different patterns of cross-linguistic transfer effects.

Cross-linguistic transfer effects of phonological awareness in Chinese-English bilingual children. Wang, Perfetti, and Liu (2005) examined the relation among three reading skills (i.e., phonological, orthographic, and word reading) in Chinese-English children from the U.S. Participants (n = 46; *M* age = 8; 2) received English instruction in school during weekdays and learned Chinese in heritage language schools on weekends. Twenty-seven of them were born in the U.S., 17 were born in Mainland China, and two were born in European countries. Mandarin was the first language for all children. They received English and Chinese experimental tasks that measured their phonological, orthographic, and word reading abilities. Onset-rime awareness was assessed in both English and Chinese. In addition, Chinese tone awareness and English phoneme awareness tasks were included. An orthographic choice task was designed for each language. For this task, the child was asked to determine whether the stimulus was a legal Chinese character or English word. For the Chinese orthographic choice task, radical position and form were manipulated. For the radical position condition, radicals were placed in wrong positions. For the radical form condition, radical forms were distorted by reducing strokes or changing stroke patterns. Each child was asked to indicate which one of the characters of a pair was not a real Chinese character. Similarly, for the English orthographic choice task, each child was asked to select an illegal English word from a pair (e.g., *ffeb* and *beff*). Cross-linguistic effects were revealed from the bivariate Pearson correlation analyses in which Chinese onset awareness was associated with English onset and rime awareness. Stepwise regression analyses also showed that Chinese tone awareness significantly predicted English real word and pesudoword reading ability. Nevertheless, there was no cross-linguistic prediction for Chinese character reading from English tasks. The authors concluded that phonological awareness seems to transfer across languages, whereas the lack of cross-linguistic transfer effects for orthographic skills indicates that Chinese and English biliteracy acquisition involves acquiring orthographic-specific skills in each language.

The disassociation between English word reading and Chinese character reading ability was also reported in two other studies. Bialystok, Luk, and Kwan (2005) examined word reading ability in four groups of bilingual and monolingual children in first grade to investigate whether there is a bilingual advantage in phonological decoding skills and whether these skills transfer from one language to the other. Three of the groups recruited from Canada were bilingual (i.e., Spanish-English, Hebrew-English, and Cantonese-English) and one was monolingual children (i.e., English). Each bilingual group represented a different combination of language and print system. All children were recruited from the same metropolitan area. The four groups were not comparable in age, so age was controlled in all the correlational analyses. The authors did not mention whether the four groups were comparable in IQ or socioeconomic status. All the children received tasks in English and in their other language. In terms of phonological decoding skills in English, both Hebrew-English and Spanish-English bilinguals performed better than English monolinguals, with large effect sizes, Cohen's $d = 1.26$ and 1.29, respectively. To examine whether phonological decoding skills transfer across languages, the author conducted correlational analyses. The results showed that Hebrew and Spanish pesudoword reading skills were associated with those skills in English, $r = .57$ ($p < .01$) and $r = .73$ ($p < .01$), respectively. Nevertheless, this pattern was not observed in Cantonese-English bilinguals, $r = -.10$ ($p = .60$).

In another study, Bialystok, McBride-Chang, and Luk (2005) compared 5- and 6-year-old monolingual English, bilingual English-Cantonese, and Cantonese-speaking children's performance on phonological awareness and word decoding tasks. The monolingual English and English-Cantonese bilingual groups lived in Canada, where school instruction was in English. The Cantonese-speaking group lived in Hong Kong and were learning English as a second language. The authors mentioned that the three groups were similar socially and educationally. It was unclear whether the three groups were comparable in IQ. Children were tested on the Peabody Picture Vocabulary Test-III (a test of receptive vocabulary), syllable deletion tasks, phoneme onset-deletion tasks, phoneme counting tasks, and word decoding tasks. Each task had both English and Cantonese versions except for the phoneme counting task. This could not be constructed in Cantonese because Cantonese is a syllable, rather than phoneme-based orthography. The English monolingual children only received tasks in English, whereas bilingual and Cantonese-speaking children completed tasks in both English and Chinese. The results showed that children across all groups performed equally well on English syllable awareness tasks (i.e., the syllable deletion task), but not the English phoneme-based awareness tasks ($\eta^2 = .40$, indicating a large effect size), with the Cantonese-speaking children performing worse than the other two groups. Moreover, the three groups performed differently on the English word-decoding tasks ($\eta^2 = .09$, indicating a medium effect size), with Cantonese-speaking children scoring lower than the other two groups. In contrast, the English-Cantonese bilingual children performed significantly worse than Cantonese-speaking children on the Chinese word-decoding tasks ($\eta^2 = .74$, indicating a large effect size). These results showed that the Cantonese-English bilinguals did not perform better than English monolinguals on the English phonological awareness tasks and English word-decoding tasks. Moreover, they performed worse than the Cantonese-speaking children on Chinese word-decoding tasks. The authors thus concluded that bilingualism did not appear to directly enhance acquisition of phonological awareness or literacy skills. Correlational analyses showed that English-decoding skills were not associated with Chinese decoding skills. The author concluded that decoding skills appeared to be specific to each language and did not transfer across languages. Overall, there was no effect of bilingualism on reading development in this study. Rather, the authors conclude that interaction among writing systems, language proficiency, and reading instruction needs to be examined carefully in order to understand children’s reading acquisition in two languages.

A conclusion can be drawn from the aforementioned studies with respect to bilingual children's reading ability in Chinese and English. The studies (Wang et al., 2005; Bialystok, McBride-Chang, & Luk, 2005) suggested that reading skills in the two languages are independent of each other and might not be transferred across languages. Each child needs to acquire a separate set of reading skills in each language. The correlational results with respect to bilingual children's phonological awareness in both languages suggested that phonological awareness can be transferred across Mandarin and English (Wang et al., 2005). Nevertheless, the phonological decoding skills as measured by pesudoword reading did not seem to transfer across languages in Bialystok, Luk and Kwan's study (2005). Moreover, Bialystok, McBride-Chang, and Luk (2005) did not find a bilingual advantage for phonological awareness in Cantonese-English bilingual children.

Oral Language and Reading

As suggested in the aforementioned studies, phonological awareness mainly contributes to children's word-level reading ability (i.e., decoding). Nevertheless, reading is more than learning to decode words. Children also need to develop reading fluency and comprehend what they read. As phonological awareness is associated with word-level reading ability, research has shown that aspects of oral language such as vocabulary and listening comprehension are related to children's reading comprehension (Catts, 1993; Oakhill, Cain & Bryant, 2003). In the next two sections, I will review the studies that examined the relation between oral language and early reading development in monolingual English-speaking and bilingual children.

Oral language proficiency and reading skills in monolingual English-speaking children. Roth, Speece, and Copper (2002) designed an exploratory study to clarify the relation between oral language and reading development. They used regression analyses to identify the variables that explained variance in early reading. The variables were categorized into four domains including background (i.e., race, gender, SES, family literacy, and IQ), structural language (i.e., semantics, morphology, and syntax), metalinguistics (i.e., phonological awareness and metasemantics), and narrative discourse (i.e., familiar story production and story comprehension). A variety of tasks were designed to measure different aspects of language. The investigators followed a group of typically developing English-speaking children from kindergarten to second grade. The original kindergarten sample consisted of 66 children but reduced to 48 and 39 in first and second grade, respectively. Oral language measures were given in kindergarten. Reading performance was assessed in kindergarten, first grade, and second grade. The reading measures in kindergarten included print awareness, letter and word identification, and pseudoword reading tests. In first and second grades, reading measures included letter and word identification, pseudoword reading, and passage comprehension tests. Consistent with previous research, results revealed that phonological awareness measured in kindergarten predicted first and second grade word (unique R^2 = .04 for first grade and unique R^2 = .60 for second grade) and pseudoword reading (unique R^2 = .04 for first grade and unique R^2 = .61 for second grade). Nevertheless, phonological awareness in kindergarten failed to predict reading comprehension in first and second grade. Instead, semantic abilities (oral vocabulary definition and word retrieval), narrative discourse, and print awareness were most predictive of reading comprehension in first and second grade. Specifically, print awareness (unique R^2 = .25), oral vocabulary definition (unique R^2 = .03), and narrative discourse (unique R^2 = .11) predicted first grade reading comprehension. Print awareness (unique R^2 = .04), oral vocabulary definition (unique R^2 = .09), and word retrieval (unique R^2 = .06) predicted second grade reading comprehension. Taken together, in addition to the importance of phonological awareness to word-level decoding, the results of this study provided evidence that vocabulary knowledge, narrative skills, and print awareness are important predictors of text comprehension.

Similar to Roth et al.'s (2002) findings, Nation and Snowling (2004) also emphasized the importance of other variables in predicting children's reading ability. They examined how oral language and phonological skills contribute to the development of reading. Participants were 72 typically developing, monolingual English speakers. They were tested at the age of 8.5 years (Time 1) and 13 years (Time 2). The child's phonological skills were assessed by a rhyme fluency test in which he/she had to generate rhyming words to the target items, and a rhyme oddity task. The child's oral language skills were measured by vocabulary, listening comprehension, and semantic skill tests. Reading measures included tests of word recognition, nonword reading, reading comprehension, and irregular-spelling word reading (e.g., *chaos* and *gnat*). Tests of oral language, phonological skills, reading (except for irregular-spelling word reading) and nonverbal ability were given at Time 1. All reading tests were given at Time 2. Two major findings revealed that oral language skills were concurrent and longitudinal predictors of children's reading comprehension. First, hierarchical regression analyses indicated that semantic skills (% R^2 change = 15.1), vocabulary (% R^2 change = 25.2), and listening comprehension (% R^2 change = 30.8) accounted for unique variance in reading comprehension at Time 1 after other variables such as age, IQ, nonword reading, and phonological skills were accounted for. Second, semantic skills (% R^2 change = 4.5), vocabulary (% R^2 change = 4.9), and listening comprehension (R^2 = 14.1) at Time 1 accounted for unique variance in reading comprehension at Time 2 after taking account of other variables such as autogressive effects of reading comprehension at Time 1, IQ, phonological skills, and nonword reading. The authors concluded that both oral language and phonological skills are important factors that contribute to children's reading development.

In sum, the aforementioned studies provided findings consistent with previous research showing that English phonological awareness is predictive of later English word-level reading ability. More important, their findings further suggested that beyond phonological awareness, oral language skills such as vocabulary and listening comprehension are also important predictors of monolingual English-speaking children's reading performance. Children's language and reading skills are closely related.

Oral language proficiency and reading skills in bilingual children. Geva and Zadeh (2006) examined how oral language and other cognitive-linguistic abilities contribute to word and text reading efficiency in English-as-a-second-language (ESL) and English-as-a-first-language (EL1) children. In this study, word reading efficiency referred to accurate and fast reading of isolated words without context, and text reading efficiency referred to accurate and fast reading of written text. Participants were 183 ESL and 67 EL1 students in second grade in Canada. The ESL group consisted of children with diverse native language backgrounds (19% Cantonese, 41% Punjabi, 18% Tamil, and 22% Portuguese). The two groups were comparable in IQ and age. SES information was not available in this study. The child's oral language proficiency was measured by an expressive vocabulary test and a grammatical judgment test. Other cognitive-linguistic abilities were assessed by tests of nonverbal intelligence, rapid automatized naming (RAN), and phonological awareness. The child's basic reading skills were assessed by word attack and word recognition subtests of the Woodcock Reading Mastery Test – Revised (Woodcock, 1987). Across two groups, the results revealed that the only EL1 advantage was their better performance than the ESL group on the oral language proficiency measures. The

ESL group, however, performed better on RAN and word reading efficiency. The authors acknowledged that further research is needed to explain why the ESL group outperformed the EL1 group on RAN and word reading efficiency measures. Both groups read faster when words were presented in context, but this context facilitation effect was more pronounced in the EL1 group. Other linguistic measures such as RAN, phonological awareness, and word reading skills contributed significantly to word and text reading efficiency in both groups. Overall, the authors concluded that despite the advantage of oral language proficiency in the EL1 group, there was no significant difference between the two groups in word and text reading efficiency. In each group, participants were further divided into three subgroups (i.e., poor decoder, low-efficient reader, and high-efficient reader). The results revealed that each EL1 subgroup had better oral language skills than any of the ESL subgroup. Nevertheless, it is worth nothing that ESL high-efficient readers outperformed EL1 high-efficient readers on the phonological awareness tasks, whereas ESL low-efficient readers and poor decoders performed worse than their EL1 counterparts on the phonological awareness tasks. Given that the EL1 and ESL groups were comparable in IQ, the authors suggested that the ESL advantage in phonological awareness could be attributed to their bilingual status.

In a recent study, Swanson, Rosston, Gerber, and Solari (2008) provided evidence that oral language proficiency measures were better predictors of reading skills than phonological awareness measures within a group of English-Spanish bilingual children. Participants were English-Spanish bilingual children in Grade 3 (n = 68, M age = 8.71 years) from low SES families. Each child was tested in three domains, including oral language proficiency, reading, and phonological awareness. English- and Spanish-equivalent measures were given to the child. In this study, oral language proficiency measures consisted of receptive and expressive vocabulary tests and a syntactic oral cloze test. Two important findings emerged. First, within a language, oral language proficiency measures contributed a substantial amount of variance to reading skills, but phonological awareness measures did not. Second, cross-linguistic effects were rather weak, with only Spanish phonological awareness being positively correlated with English phonological awareness, and Spanish word identification and word attack being negatively correlated with those measures in English. The authors concluded that oral language and reading skills become more strongly related when children enter third grade and reading comprehension becomes an important reading skill. In particular, L2 reading skills are associated with L2 oral language proficiency ability. Also, the negative correlation between English and Spanish measures seems to suggest a trade-off in terms of how proficient a bilingual child can be in reading in each of his or her two languages.

Similar to the purpose of the two aforementioned studies, Miller et al. (2006) examined the relation between bilingual children’s oral language and reading skills. In this study, oral language proficiency was measured through narrative discourse. Participants were Spanish-English bilinguals enrolled in transitional bilingual programs from kindergarten through third grade (n = 1531). In this study, bilingual children placed in transitional bilingual programs were regarded as having insufficient English skills to perform adequately in a mainstream classroom. Oral narrative samples were elicited from a wordless picture book, *Frog, Where are you?* (Mayer, 1969). The elicitation procedure followed a story retelling paradigm (Strong, 1998). In addition, each child was tested on isolated word reading efficiency and passage reading comprehension. The predictive power of oral language proficiency skills was observed within and across languages. Specifically, oral language proficiency in Spanish predicted Spanish reading skills and oral language proficiency in English predicted English reading skills. Cross-linguistic effects were evident from the results that Spanish oral language proficiency predicted English reading skills and English oral language proficiency predicted Spanish reading skills.

To summarize, the aforementioned three studies reported mixed results in terms of whether there is a cross-linguistic relation between oral language and reading skills in bilingual children. Nevertheless, taken together, it is evident that oral language proficiency does play an important role in reading skills within a language. The mixed results might have caused by other confounding variables that were not directly measured or controlled for but might as well influence bilingual children's language and reading performance. The following study suggests a potential demographic variable that seems to impact bilingual children's later reading performance.

Studies of bilingual reading acquisition that I have reviewed so far have mainly focused on skills of transfer (i.e., phonological awareness and decoding ability) across languages and how oral language proficiency in a second language determines second language reading achievement. A recent study by Kovelman, Baker, and Petitto (2008) suggested a new perspective into studying bilingual reading development by taking into account the age of bilingual children's first exposure to a second language. This study examined how age of first bilingual language exposure influences Spanish-English bilingual children's language proficiency and reading development in both languages. Four groups of Spanish-English bilingual children and one group of English monolingual children in Grades 2 to 3 participated in this study. All bilingual groups attended Spanish-English bilingual schools where instruction was given in each language 50% of the time. Three of the bilingual groups came from Spanish-speaking families and had different ages of first exposure to English (i.e., 0-3, 3-4, and 5-6 years). The other bilingual group was from English-speaking families and had Spanish exposure between the ages 5 and 6 years. The monolingual English group was from English-speaking families and attended English-only schools. Each child completed phonological awareness, reading and language tasks. All bilingual groups received tasks in Spanish and English, whereas the monolingual group only received English tasks. The phonological awareness tasks included initial and final phoneme deletion and phoneme segmentation tasks. The reading tasks were regular, irregular, and pseudoword reading and passage comprehension tasks. A standardized language Competence/Expressive Proficiency (LCEP) task was used to assess children's expressive language proficiency.

The results in Kovelman et al's (2008) study showed that age of first exposure to both English and Spanish had a significant influence on bilingual children's phonological awareness and reading performance in English and Spanish, with early bilinguals (ages 0-3 years) performing equally well as the monolingual group and better than late bilinguals (ages 3-6 years). Moreover, early bilinguals showed equally high language proficiency in English as English monolinguals. All bilinguals from Spanish-speaking families outperformed the bilinguals from English-speaking families in Spanish language tasks.

Kovelman et al.'s (2008) study was the first to systematically examine the effects of age of first language exposure on reading development. Age of first language exposure appears to be an important factor contributing to bilingual children's reading development. Nevertheless, English and Spanish are two typologically related languages. Previous cross-linguistic studies have shown positive association of reading skills in this language pair. Therefore, as the authors indicated in the article, whether the influence of age of first language exposure on reading development would be observed in other languages pairs requires further investigation.

A Research Framework for Reading Acquisition in Bilingual Children

For the past century, a considerable number of bilingual studies have contributed to our understanding of the effects of childhood bilingualism on children's language and reading performance. As can be seen from the studies reviewed so far, research has reported conflicting results regarding bilingual effects on children's reading acquisition. In order to account for the mixed results of these studies, Bialystok (2002, 2007) proposed a research framework for the study of bilingual literacy acquisition. This framework identifies three areas of research that are relevant to bilingual literacy acquisition. Based on the three areas of research, she defines three prerequisite skills that are essential for children to become literate. These three skills are oral language proficiency, concepts of print, and metalinguistic (phonological) insights into one's language. Using this research framework to review a large body of research, she discusses how being bilingual may change children's developmental course of these skills in their first and second languages. In addition, she discusses how these prerequisite skills may, in turn, influence bilingual children's reading acquisition in L2.

From Bialystok's (2002, 2007) review of the literature on oral language proficiency, bilingual children appear to be at risk of having inadequate oral language proficiency in their second language which in turn may interfere with their reading ability in that language. The major cause of the inadequate oral language proficiency appears to be bilingual children's vocabulary size. Several studies have shown that bilingual children have a smaller vocabulary size compared to their monolingual peers in either first or second language. Nevertheless, analysis of translation equivalents (i.e., words shared by two languages) suggested that bilingual children know more vocabulary concepts than those revealed by a single-language standardized vocabulary test (Merriman & Kutlesic, 1993; Pearson & Fernández, 1994; Umbel, Pearson, Fernández, & Oller, 1992).

On the other hand, from Bialystok's (2002, 2007) review, research has suggested that bilingualism enhances children's concept of print. Concept of print refers to the notions of how written words encode sound and meaning and an understanding of the arbitrary relationship between a word and its meaning. For example, experimental tasks typically examine how children understand that the meaning encoded in written forms is invariant (e.g., the written form of *dog* cannot be arbitrarily altered and used to represent the concept of *cat*). Results of several studies have shown that bilingual children develop these concepts earlier and better than their monolingual peers (Bialystok, 1997; Bialystok, Shenfield, & Codd, 2000).

Unlike its effect on oral language proficiency and concept of print, bilingualism seems to have a neutral effect on children's development of phonological awareness. Bialystock (2002, 2007) identifies two important patterns from studies in this area. First, the outcome may depend on specific phonological awareness tasks, because they assess different phonological units and the tasks place different levels of cognitive demands on children. Second, the performance difference on phonological awareness tasks between bilingual and monolingual children often disappear by first grade, which might suggest that reading instruction could level out children's phonological awareness ability once reading is underway (Bruck & Genesee, 1995). Therefore, bilingualism *per se* seems to play a neutral role in children's development of phonological awareness.

In sum, Bialystok's research framework (2002, 2007) provides a description of how bilingualism changes the developmental course of the three background skills required for reading and the extent to which these skills in both languages (i.e., oral language proficiency, concept of print, and phonological awareness) influence bilingual children's L2 reading acquisition. As the three skills each indicate a positive (concept of print), negative (oral language proficiency) and neutral (phonological awareness) effect for bilingual children, the author concludes that bilingualism does play a role in children's reading development, but it is important to keep in mind that its effect is not unitary.

The Threshold Hypothesis

In addition to Bialystok's (2002, 2007) research framework for bilingual reading acquisition, a theoretical framework proposed by Cummins in the 1970s also contributes to the explanation of inconsistent bilingual outcomes. Several bilingual studies have yielded opposite results regarding the relationships between bilingualism and cognition. Some studies have reported that bilingual children perform significantly lower than their monolingual peers on verbal and cognitive tests, whereas others conclude that bilingualism can enhance children's academic performance and cognitive functioning (For a review, see Cummins, 1979).

In an attempt to resolve these mixed findings and provide a theoretical framework for bilingual research, Cummins (1979) proposed a threshold hypothesis which addresses the relation between cognition and bilingualism. The threshold hypothesis suggests that bilingual children's level of competence in their two languages is an important factor that determines how bilingualism influences their cognitive growth. Specifically, bilingual children need to reach certain threshold levels of language proficiency in a second language to avoid detrimental effects and to enjoy potential cognitive benefits of being bilingual. There are lower and higher threshold levels. When bilingual children reach the lower threshold level, they can avoid any negative cognitive effects. The achievement of the higher threshold level leads to positive cognitive growth. There are no absolute definitions or cutoff points for the thresholds. Instead, Cummins stresses that the threshold would depend on the interaction between children's different levels of cognitive development and the academic demands placed on children at a specific period of time. For example, the lower threshold for bilingual children in early elementary grades may involve basic listening comprehension and expressive skills, whereas basic reading comprehension skills may be the lower threshold for children in later elementary grades.

Research support for the threshold hypothesis. Lee and Schallert (1997) examined the relative contribution of L2 (English) language proficiency and L1 (Korean) reading ability to L2 (English) reading comprehension in Korean middle and high school students who were learning English as a foreign language (EFL). To test the threshold hypothesis, the authors predicted that only students with high L2 language proficiency would show a positive relation between their L1 reading and L2 reading skills. In other words, statistically significant correlations between L1 and L2 reading scores would only be observed in students who reached a certain level of L2 language proficiency. Participants were 809 third-year middle school and first-year high school, Korean EFL students (equivalent to 9^{th} and 10^{th} grades in the U.S.). Each student received an English language proficiency test that evaluated English vocabulary knowledge and grammatical ability, an English reading comprehension test, and a Korean reading comprehension test. The students were originally placed into 10 levels based on their L2 language proficiency test scores, with approximately 10% of the entire sample in each group. The Pearson product-moment correlation coefficients between L1 and L2 reading skills were low and not statistically significant in Levels 2 (r = .09, p = .45) and 3 (r = .15, p = .18). In addition, there was a large gap in the correlations between Levels 3 (r = .15, p = .18) and 4 (r = .34, p = .01).

The gap between Levels 3 and 4 seems to support the threshold hypothesis. Nevertheless, the authors noted that the correlation between L1 and L2 reading skills in Level 1 was barely significant (r = .22, p = .05). The authors were concerned that the significant correlation in Level 1 may not be supportive evidence for the threshold hypothesis. As a result, the authors regrouped the students into five levels according to their performance on the English language proficiency test, with 5 being the highest proficiency level. Based on the second grouping, the correlations between L1 and L2 reading at Levels 1 (r = .22, p = .05) and 2 (r = .17, p = .03) were low, whereas the correlations at Levels 3 (r = .38, p = .01), 4 (r = .43, p = .01), and 5 (r = .47, p = .01) were moderate. Furthermore, the correlation coefficients of the relation between L1 and L2 reading for each adjacent language proficiency level pair indicated a critical cutoff point between Levels 3 and 4. Taken together, students who achieved a certain level of English language proficiency demonstrated a positive relation between their English and Korean reading achievement. The authors concluded that their results supported the threshold hypothesis.

Lasagabaster (1998) tested the threshold hypothesis in a trilingual context where Basque and Spanish were taught in school as official languages and English as a foreign language. Participants were 126 5th graders and 126 8th graders who were in their second and third year of learning English at school, respectively. The independent measures were students' Basque, Spanish, and English proficiency. Reading and writing standardized tests published by the department of education of the Basque government were used to evaluate Basque and Spanish language proficiency. English proficiency was evaluated by a test of vocabulary, grammar and four linguistic skills (listening, speaking, writing, and reading). The dependent measure was students' Spanish metalinguisitic awareness (THAM-2, Pinto & Titone, 1995). Composite scores were formed for the three proficiency tests. Composite scores were then converted to t-scores to avoid decimals.

Two hypotheses were proposed: one predicted that there would be three threshold levels in a trilingual situation and the other predicted that there would be two threshold levels. The median t-score for each language proficiency test was used as a cutoff score. Students who scored below the median were considered to have achieved low competence in the language, whereas those who scored above the median were considered to have achieved high competence in the language.

To test the first hypothesis, the students were divided into four linguistic groups, having: high competence in three languages, high competence in two languages, high competence in one language, and low competence in three languages. The results showed that students who had high competence in three languages significantly outperformed the other three groups. Nevertheless, there was no group difference between students who had high competence in two languages and those who had high competence in one language; both groups significantly outperformed students who had low competence in three languages. The pattern of group differences in Grades 5 and 8 was similar. As a result, the authors concluded that the results did not support the existence of three threshold levels.

To test the second hypothesis for two threshold levels, the students were divided into three linguistic groups based on their performance on the language proficiency tests. The three linguistic groups included students who had high competence in three languages, high competence in one or two languages, and low competence in three languages. Paired t-tests showed that those who had high competence in three languages outperformed the other two groups on the metalinguistic awareness test. Also, those who had high competence in one or two languages outperformed those who had low competence in three languages. The pattern of group differences in Grades 5 and 8 was similar. The author concluded that two thresholds were identified for trilingual children's metalinguistic awareness.

Lasagabaster's (1998) study seems to support the threshold hypothesis. Nevertheless, the group differences found among the three groups may not be sufficient to support the threshold hypothesis and could be interpreted in a different way. For example, the relation between language proficiency and metalingusitic awareness might be linear. Also, the author mentioned that IQ and SES favored the groups that were competent in three languages, and even one or two languages. The author, however, did not statistically control these confounding variables.

In sum, results of the two aforementioned studies supported the threshold hypothesis using a group design. Nevertheless, both studies showed that it was difficult to accurately identify the actual threshold level(s) using the initial grouping criteria. Cummins (1979) indicated that the threshold level may vary according to children's different developmental stages and academic demands. Without a clear definition of where the threshold would be, it seems difficult to test the threshold hypothesis. To identify the threshold level(s) using a group design, it seems more reasonable to first examine the data by setting up a scatter plot. Any discontinuity observed in the scatter plot may be helpful in further identifying the accurate threshold level(s).

Bilingual Research Paradigms

Most of the aforementioned bilingual studies focused on comparing bilingual children with their monolingual peers on language or reading achievement. The following two studies represent another bilingual research paradigm that has been labeled the within-bilingual-sample design (Hakuta & Diaz, 1985). Originally, the goal of this design was to study bilingual children who vary in their second-language proficiency. Additionally, adapting a similar design can help resolve a number of potentially confounding factors in bilingual research, such as SES, age of arrival in a new country, age of first exposure to a second language, and heritage language status in the community.

Within-bilingual sample design. Bialystok (1988) investigated how the degree of bilingualism can play a role in determining the effects of bilingualism on children's metalinguistic development. Two types of linguistic awareness were defined: analysis of linguistic knowledge and control of linguistic processing. *Analysis of linguistic knowledge* refers to the skills responsible for making explicit one's linguistic knowledge. For example, writing and providing definitions of language structure require explicit analysis of linguistic knowledge, but conversation would not need to be supported by explicit analysis of linguistic knowledge. *Control of linguistic processing* refers to the skills relating to selecting and integrating linguistic information. For example, reading involves high control of linguistic processing. Readers need to pay attention to orthography, syntax, semantics, and context and, at the same time, integrate all the information to comprehend the text. Compared to the process of reading, carrying a conversation requires relatively lower control of linguistic processing. The author hypothesized that bilingual children will outperform monolingual children on tasks requiring control of linguistic processing. Furthermore, fluent bilinguals will outperform partial bilinguals in terms of analysis of linguistic knowledge. Two studies were conducted to test these two hypotheses.

Study 1 used a between-groups design. Three groups of children in Grade 1 participated: 20 monolingual English speaking children, 20 partial French-English bilingual children and 17 fluent French-English bilingual children. The partial bilinguals had been taught French in an immersion program for almost two years, whereas the fluent bilinguals were exposed to French through family members. The three groups were comparable in IQ and SES (middle to upper-middle class families). Children’s language proficiency was measured by the Peabody Picture Vocabulary Test (PPVT). A French translation of PPVT was given to the two bilingual groups. Control of linguistic processing was measured by two tasks: one assessed the child’s understanding of the arbitrary relation between a linguistic form and its referent (e.g., if someone decided to call the sun “the moon” and call the moon “the sun,” what would you call the thing in the sky when you go to bed at night?); the other measured the child’s concept of word (e.g., “what is a word?”). Analysis of linguistic knowledge was measured by a syntax correction task. The results showed that both bilingual groups performed better on the tasks measuring control of linguistic processing than the monolingual group. Furthermore, the fluent bilinguals were better at the tasks assessing analysis of linguistic knowledge than were the monolingual and partial bilingual children.

Study 2 used a within-groups design to further test the hypothesis that fluent bilinguals would outperform partial bilinguals on tasks requiring analysis of linguistic knowledge. The child was asked to judge whether a sentence was grammatically correct. Participants were first-grade English-Italian bilinguals from working-class immigrant areas in Canada. Fluent bilinguals were distinguished from partial bilinguals based on a median cutoff score for the Italian PPVT. It was unclear whether the two groups differed in IQ. Four types of sentences were included: grammatically and semantically correct sentences, grammatically incorrect and semantically incorrect sentences, grammatically incorrect but semantically correct sentences (e.g., “Why the dog is barking so loudly?”), and grammatically correct but semantically incorrect sentences (e.g., “Why is the cat barking so loudly?”). The first two types assessed analysis of linguistic knowledge, whereas the second two measured control of linguistic processing. The results confirmed the hypotheses. The two bilingual groups were not different on tasks requiring control of processing. Fluent bilinguals outperformed partial bilinguals, however, in terms of analysis of knowledge. The author concluded that the extent to which a child is bilingual is important in determining the bilingual effect on children's development of linguistic awareness. Bialystok's (1988) study supports the results of an earlier study by Hakuta and Diaz (1985).

A shortcoming of the Bialystok's (1988) study is that the rationale does not seem to correspond to the grouping criteria used to determine fluent and partial bilingualism. The author hypothesized that it is the experience of processing and analyzing two languages (e.g., reading and writing) that accelerates fluent bilinguals' linguistic awareness and stressed that being able to speak two languages does not necessarily produce this advantage. Nevertheless, the two bilingual groups were separated based on children's PPVT scores which assessed children's receptive language. The PPVT may not be sufficient to represent children's experience of analyzing two linguistic systems.

A more recent study by Shwartz, Leikin, and Share (2005) also employed a within-bilingual-sample design. They predicted that biliteracy is the key factor that influences bilingual children's development of phonological awareness and L2 literacy acquisition. Two bilingual groups (i.e., biliterate and monoliterate Russian-Hebrew children) and one monolingual Hebrew group were compared on their early Hebrew literacy (L2) development. Russian (L1) was the primary language spoken at home for all the bilingual children. All children were living in Israel where Hebrew is the official language. The biliterate group had received one year of reading instruction in Russian whereas the monoliterate group had received no formal or informal reading instruction. The three groups were comparable in IQ but not maternal and paternal education. Paternal and maternal education in the bi-literate bilingual group was higher than in both the mono-literate bilingual and in turn monolingual groups. As a result, analysis of covariance was conducted to control for these differences. All the children were given linguistic, metalinguistic (including phonological awareness), and cognitive tasks at the beginning of Grade 1 and reading and writing tests in Hebrew at the end of Grade 1. All linguistic and metalinguistic tasks were administered in two languages. Results showed that the biliterate group performed significantly better than monolingual and monoliterate groups on all the phonological awareness tasks. Also, after adjusting for differences in emergent literacy skills at the beginning of Grade 1, the biliterate group achieved significantly higher literacy skills than the other two groups. Previous studies had yielded mixed results in terms of how bilingualism plays a role in the development of phonological awareness. This longitudinal study demonstrated that early L1 literacy acquisition but not bilingualism *per se* could accelerate the development of phonological awareness and L2 literacy development. This study contrasted two bilingual groups who learned two writing systems that have regular grapheme-phoneme correspondence. In this case, children's gains in L2 literacy skills could be attributed to the effect of cross-linguistic transfer. In other words, insight into the alphabetic principle gained in L1 (Russian) literacy could be applied to L2 (Hebrew) literacy.

To conclude, the preceding studies which used the within-bilingual-sample design have demonstrated that within a group of bilingual children, performance on language and reading tasks can vary. This indicates that the bilingual population cannot be considered a homogeneous group. Several confounding factors such as SES, IQ, age, and age of first exposure to a second language need to be well controlled. If group differences for these confounding factors are observed, statistical analyses that control for these factors should be employed. Age, IQ, and SES were the three confounding factors commonly controlled in the bilingual studies reviewed in this chapter. Nevertheless, only Bruck and Genesee (1995) controlled for all three of them in the same study. None of the studies controlled for bilingual children's age of first exposure to a second language. Table 2 is a summary of the controlled factors in the bilingual studies reviewed in this chapter.

Rationale of the Present Study

The literature review in this chapter summarizes current research findings on reading and two important reading-related domains, phonological awareness and oral language proficiency. Research has addressed the question of how these two domains interact with reading acquisition. Results regarding the relation of each with reading outcomes in bilingual children are still mixed. Most of the research has focused on the directionality of how phonological awareness and/or oral language proficiency influence children's reading achievement. Nevertheless, given that there exists a reciprocal relation between each domain and reading, it is also important to examine how reading experience may alter the development of phonological awareness and oral language proficiency, especially in children who have started to accumulate a certain level of reading experience. The effects of biliteracy acquisition in children are overlooked in Bialystok's (2002, 2007) research framework. As bilingualism may change the developmental course of the three prerequisite skills, it is possible that learning to read two print systems would also influence the development of these three skills. My dissertation aimed to examine how learning to read in two different writing systems would impact Taiwanese Mandarin-English bilingual children's oral language proficiency and phonological awareness skills. The participants were bilingual children in 2nd to 3rd grade. The development of the concept of print would be outside the scope of the present study, because this is regarded as one of the emergent literacy skills among preliterate children.

Moreover, current studies on Chinese and English biliteracy acquisition seem to conclude that learning to read a writing system is a language-specific task (Bialystok et al., 2005; Wang et al., 2005). Children need to master reading skills required for each writing system. Nevertheless, these studies fall short of taking into account of bilingual children's reading expertise and mainly involve bilingual children who have just begun learning to read (i.e., kindergarten or first grade). It is possible that once children reach a certain level of reading achievement, reading skills in one language would boost those in the other and reading-related skills would thus be altered. The present study tested this hypothesis in Chinese-English biliteracy acquisition.

Similar to the higher threshold level in the threshold hypothesis (Cummins, 1979), I hypothesized that a threshold level of Chinese reading ability was required for bilinguals to obtain advantages from learning to read two print systems. A small attainment in learning to read Chinese would not be sufficient to enhance bilingual children's oral language proficiency in both languages and English reading skills. As a result, I predicted that only advanced readers who had the highest achievement in learning to read Chinese would enjoy accelerated effects. Children who were beginning to acquire Chinese reading skills should perform similarly to the children who had not yet learned to read Chinese.

Research Questions

The purpose of the present study was to investigate the effects of learning two writing systems on children's phonological awareness in Chinese and English, oral language proficiency in Chinese and English, and reading skills in English. Extending the commonly employed bilingual research paradigm, which directly compares one bilingual group with one or two monolingual groups, the present study incorporated a within-bilingual-sample design to specifically examine how biliteracy effects would differ, if at all, in children with various levels of Chinese reading expertise. Each bilingual subgroup was compared with a monolingual English-speaking group which represented a population that was speaking one language and learning to read one writing system. This design would allow closer observation of bilingual effects on reading acquisition. The specific research questions are as follows:

1. Do Taiwanese Mandarin-English bilingual children's phonological awareness skills in both languages differ as a function of their level of Chinese reading ability?
2. Do bilingual children's oral language proficiency in both languages differ as a function of their level of Chinese reading ability?
3. Do bilingual children's English reading skills differ as a function of their level of Chinese reading ability?
4. Does each Mandarin-English bilingual subgroup differ from a monolingual English-speaking group in English phonological awareness, oral language proficiency, and reading skills?

Specific Hypotheses and Anticipated Outcomes

With regard to the first research question, due to a reciprocal relation between phonological awareness and literacy skills as suggested by previous research (Shwartz et al, 2005), I hypothesized that children with better literacy skills would have a better understanding of the sound structure of their language. Therefore, I hypothesized that a graded effect for phonological awareness ability would be observed in three groups of bilingual children. Specifically, I predicted that bilingual children who were advanced Chinese readers (a Chinese Advanced Reader group) would have higher levels of phonological awareness skills than bilingual children who had only limited Chinese reading ability (a Chinese Beginning Reader group), and that the latter group in turn would have higher levels of phonological awareness skills than bilingual children who were just in the very initial stage of learning to read Chinese (a Chinese Nonreader group). The hypotheses would be supported if group differences on the phonological awareness tasks were observed.

The rationale for the anticipated outcome of the second research question was similar to that of the first research question. Reading experience was predicted to play a role in enhancing children's oral language proficiency. I hypothesized that children who read more and better would tend to use more literate structures and different words in their spoken language. Following this line of reasoning, bilingual children in the Chinese Advanced Reader group were expected to obtain higher scores on the oral language proficiency tasks than those in the Chinese Beginning Reader and the Chinese nonreader groups. There may not be a group difference between the Chinese Beginning Reader group and the Chinese Nonreader group. Based on the concept of the threshold hypothesis (Cummins, 1979), I hypothesized that a threshold level of Chinese reading ability was necessary to lead to bilingual children's accelerated oral language proficiency. The threshold hypothesis proposed by Cummins (1979) focuses on the threshold levels of bilingual children's spoken language proficiency in a second langauge. In the present study, the threshold levels focused on bilingual children's Chinese reading ability. Bilingual children in the Chinese Beginning Reader group had only attained limited Chinese literacy skills which may not be sufficient to boost their oral language proficiency in both languages.

Similarly, with respect to the third research question, a threshold level of Chinese reading ability was expected to allow for positive transfer of reading skills across languages. Therefore, I hypothesized that the Chinese Advanced Reader group would attain higher scores on the English reading tasks than the Chinese Beginning Reader and the Chinese Nonreader groups. The Chinese Advanced Reader group's higher English reading ability would indicate cross-linguistic transfer (i.e., from Chinese to English). I also hypothesized that there would be no group differences between the Chinese Beginning Reader and Chinese Nonreader groups.

Regarding the fourth research question, I hypothesized that a monolingual English-speaking group would perform similarly to the Chinese Nonreader group in English phonological awareness, oral language proficiency, and English reading outcomes, because both of the groups would be learning to read only one writing system. Specifically, in terms of English phonological awareness, the Chinese Advanced Reader group would outperform the Chinese Beginning Reader group, who in turn would outperform the Chinese Nonreader group and the English Monolingual group. In terms of English oral language proficiency and English reading outcomes, the Chinese Advanced Reader group would outperform the other three groups.

Chapter Three

Methods

Participants

Sixty-six children in Grades 2 and 3 initially completed the research protocol. Forty-six of them were Taiwanese Mandarin-English speaking bilingual children, recruited from Chinese heritage schools in three Midwestern cities in the U.S. Twenty of them were European American monolingual English-Speaking children from two Midwestern cities in the U.S. All participants had normal hearing at the time of data collection.

Of the 46 bilingual children in Grades 2 and 3 who initially participated in this study, six were not retained for the analyses. One of the six children was not able to complete four of the measures. Another child was not able to fully attend to the entire testing session, so the results may not have truly reflected his ability. One child was not able to complete any of the English measures. Another child had limited English oral and reading ability, so it was necessary for me to help him complete most of the English measures. One child was not able to read traditional Chinese characters on the Graded Chinese Character Recognition Test (Huang, 2001). The sixth and remaining child was the only participant of all those recruited who was categorized as a Chinese advanced reader. Data obtained from this child will be reported and discussed separately.

Thus, 60 children in Grades 2 and 3 remained for inclusion of the present study: 40 Taiwanese Mandarin-English speaking bilingual children and 20 European American monolingual English-speaking children. The bilingual children were assigned to two groups (i.e., Chinese Beginning Reader group and Chinese Nonreader group) based on their performance on the Graded Chinese Character Recognition Test (Huang, 2001). According to my preselected cutoff score, 20 Taiwanese Mandarin-English bilingual children were assigned to a Chinese

Beginning Reader group, and 20 to a Chinese Nonreader group. One point was given for every correctly pronounced Chinese character out of 200 characters, with a maximum score of 200. This test was normed on monolingual children in Taiwan. According to the norms, the mean score is 24.31 correctly read characters for first graders, 46.84 for second graders, and 64.55 for third graders. Bilingual children in the U.S. learned to read Chinese as a heritage language so their Chinese reading ability may not be comparable with that of children in Taiwan. Therefore, cutoff scores for group assignment were decided as follows: Children who scored above 35 were placed in the Chinese Advanced Reader group, between 10 and 35 in the Chinese Beginning Reader group, and below 10 in the Chinese Nonreader group. See Table 3 for means and standard deviations of the Graded Chinese Character Recognition Test for each group.

According to parents' report on the Language Background Survey (see Appendix A), the children in the bilingual groups were born and lived in the U.S. except for two who were born in Taiwan. One of them was a Chinese Beginning Reader. He moved to the U.S. at the age of 2 years. The other was a Chinese Nonreader. He moved to the U.S. at the age of 6 years. All of the children in the bilingual group had at least one parent who was a native speaker of Mandarin. Other languages spoken as a native language by the parents included English (5), Cantonese (1), and Korean (1). According to the data obtained from the Language Background Survey, some bilingual children spoke Mandarin as their primary language at home, whereas others spoke both Mandarin and English at home. Specific information regarding the amount of bilingual children's language input and output will be discussed later. Monolingual English-Speaking children were born and lived in the U.S., except for one who was born in the U.K. This child had moved to the U.S. when he was 8 months old. All monolingual English-Speaking children spoke English as their primary language at home.

All the bilingual and monolingual children received education in English. The bilingual children were learning to read and write Chinese by attending a Chinese heritage school on the weekends. The Chinese heritage school typically offered Chinese language and literacy classes for 2 to 3 hours per weekend.

Demographic information for participants. A language background survey (see Appendix A) was given to parents. The first page, which contained questions regarding parents' occupations, highest educational levels, and the child's language and literacy background, was filled out by parents. The bilingual children's parents filled out additional sections which included parents' rating of the child and parents' language proficiency in Mandarin and English, and questions regarding the amount of the child's language input and output in each language, and the child's years of exposure to each. Data obtained from the survey is as follows.

Age, gender, socioeconomic status, and nonverbal intelligence for all children. Table 4 is a display of age, gender, socioeconomic status (SES), and nonverbal intelligence for each group. A one-way ANOVA revealed no significant differences among the three groups with respect to age, $F(2, 57) = .281$, $p = .756$. A chi-square analysis indicated the three groups were not comparable in gender distribution, $\chi^2(2) = 8.571$ $p = .014$. As can be seen from Table 4, the Chinese Nonreader group consisted of more males than females.

A one-way ANOVA revealed no significant differences among the three groups with respect to the family's SES, $F(2, 56) = .739$, $p = .482$. The Hollingshead Four Factor Index of Social Status (1975) was used to determine the SES for each child's family. According to this measure, education and occupation are two important factors that contribute to an individual's overall social status score. Educational level is scored on a 7-point scale, with 7 being a graduate degree. Occupational level is scored on a 9-point scale, with 9 referring to "higher executives, proprietors of large businesses, and major professionals" (Hollingshead, 1975, p. 5), e.g., engineers, lawyers, physicians, and teachers at the university level. An individual's social score is the sum of the score for education multiplied by three (3) and the score for occupation multiplied by five (5). To estimate a social status score for each child's family (a nuclear family), parents' social status scores were averaged. For example, the social status score for a child whose father is an engineer (doctoral degree) and whose mother is a professor (doctoral degree) is 66.

Each child's nonverbal intelligence was assessed using the Test of Nonverbal Intelligence, Third Edition (*TONI-3*, Brown, Sherbenou, & Johnson, 1997). Each child's raw score was converted to a quotient according to the norm. A one-way ANOVA revealed no significant group differences for performance on the TONI-3, $F(2, 56) = 2.915$, $p = .062$, observed power = .547, although the F value had borderline significance.

English language and literacy background information for all children. Table 5 is a display of information regarding the age of first exposure to English, years of receiving formal English literacy instruction, whether parents read with the child at home, and children's performance on the print exposure test: the English Title Recognition Test (for further detail, see Appendix I). Statistical analyses showed that the three groups were comparable in English language and literacy background. Specifically, in the language background survey, parents were asked to circle an age range in which the child was first exposed to English. A chi-square analysis revealed no statistically significant effect on the age of first exposure to English, $\chi^2(4) = 7.414$, $p = .116$. Parents also reported how many years of formal English literacy instruction the child had received. A one-way ANOVA revealed no significant differences among the three groups for years of receiving formal English literacy instruction, $F(2, 56) = .714$, $p = .494$.

Parents indicated whether they read with the child in English at home. A chi-square analysis did not reveal a significant effect on whether the parents read with the child in English at home, $\chi^2(2) = 3.201$, $p = .202$. In the English Title Recognition Test, the child was asked to circle the book titles that he or she had read before. A MANOVA on two variables (i.e., English Title Recognition Test: Picture Books and English Title Recognition Test: Chapter Books) revealed no significant differences among the three groups for performance on the English Title Recognition Test, Wilks' Lambda $F(4, 112) = .595$, $p = .667$.

Chinese language and literacy background information for bilingual children. Table 6 is a display of information for the Chinese Beginning Reader group and the Chinese Nonreader group regarding the distribution of language input and output in Chinese and English, child's language proficiency as rated by parents, years of receiving formal Chinese literacy instruction, and whether parents read with the child in Chinese at home. Information regarding children's exposure to TV in Chinese was not obtained from this survey. Nevertheless, through personal communication, several parents indicated that their child was exposed to Chinese TV or movies more than Chinese books. They also mentioned that their child learned Chinese vocabulary or characters by reading the subtitles in Chinese TV shows or movies. As a result, TV shows or movies seem to be important language learning materials for bilingual children in the U.S. Future research may need to obtain information regarding the amount of exposure to TV shows or movies in each language in which the child receives input.

The parent respondent reported who the child spent time with, the number of hours the child spent time with the person or people each week, and in which language the person or people spoke to the child and in which language the child responded. If both languages were used, the parents reported the percentage of language use in each language. The percentage of language input and output was then calculated by dividing the number of hours of using the language by the total number of hours when the child was awake, as reported by the parents. A MANOVA on an array of variables (i.e., English input, Chinese input, English output, and Chinese output) revealed a significant main effect, Wilks' Lambda $F(4, 35) = 2.725$, $p = .045$, partial eta squared = .237, indicating a large effect size. Follow-up univariate ANOVAs revealed that Chinese Beginning Readers received significantly more Chinese input than Chinese Nonreaders, $F(1, 38) = 5.134$, $p = .029$, whereas Chinese Nonreaders received significantly more English input than Chinese Beginning Readers, $F(1, 38) = 4.416$, $p = .042$. Chinese Beginning Readers produced significantly more Chinese output than Chinese Nonreaders, $F(1, 38) = 8.194$, $p = .007$, whereas Chinese Nonreaders produced significantly more English output than Chinese Beginning Readers, $F(1, 38) = 8.329$, $p = .006$.

Parents were asked to rate the child's language proficiency in English and Chinese as in the work of Gutierrez-Clellen and Kreiter (2003). According to these authors, a score of 2 indicates the child has, "Limited proficiency with grammatical errors, limited vocabulary, understands the general idea of what is being said"; a score of 3 indicates the child has, "Good proficiency with some grammatical errors, some social and academic vocabulary, understands most of what is said"; and a score of 4 indicates the child has, "Native-like proficiency with few grammatical errors, good vocabulary, understands most of what is said" (p. 285). A MANOVA on two variables (i.e., English proficiency and Chinese proficiency) revealed no significant main effect for language proficiency in each language as rated by the parents, Wilks' Lambda $F(2, 33) = .287$, $p = .753$.

A one-way ANOVA revealed a significant group difference for years of receiving formal Chinese literacy instruction, $F(1, 38) = 7.406$, $p = .01$, with Chinese Beginning Readers receiving formal Chinese literacy instruction approximately 1 year longer (M = 3.62, SD = 1.36) than Chinese Nonreaders (M = 2.50, SD = 1.24). A chi-square analysis also revealed a main effect for whether parents read with the child in Chinese at home, $\chi^2(1) = 3.956$, $p = .047$, with 80% (16/20) of parents of Chinese Beginning Readers reporting "yes" compared to only 50% (10/20) of parents of Chinese Nonreaders.

Materials

A battery of tests was administered to each child. In addition to a nonverbal intelligence test and an exposure to print measure, there were three blocks of tasks, including phonological awareness tasks, reading tests, and oral language proficiency tests. Phonological awareness tasks and the Chinese reading comprehension test were designed for the purpose of this study by the author. Other English and Chinese reading tests and the nonverbal intelligence test were standardized measures. The exposure to print measure, the English Title Recognition Test, included items developed by Cunningham and Stanovich (1991) and book titles selected from The New Read-Aloud Handbook (Trelease, 1989). The Language Background Survey was adapted from two bilingual studies (Gutierrez-Clellen, & Kreiter, 2003; Kovelman, Baker, Petitto, 2008). Table 7 is a summary table of all the assessment measures.

Given that bilingual children differ in their level of Chinese reading ability, the reading tests administered to children in each group varied. The Chinese reading comprehension test was planned to only be given to the Chinese Advanced Reader group because only this group was expected to be able to read Chinese passages. Therefore, only the Chinese Advanced Reader completed this test. Monolingual English-Speaking children completed the English session and the nonverbal intelligence test. Parents filled out the first page of the language background survey for the Monolingual English-Speaking children. Table 8 is a display of the tasks that were administered to each group.

Phonological awareness tasks.

Description. The child's phonological awareness skills were assessed through a set of phonological awareness tasks created for the purpose of the present study. Parallel tasks in English and Mandarin were created. The English tasks measured children's onset-rime and phonemic awareness. The Mandarin tasks assessed onset-rime and tone awareness.

Based on the studies reviewed earlier, the English phonemic awareness task and Mandarin tone awareness task are parallel in the sense that they are of equal importance to language processing in each language (Cheung et al., 2001; McBride-Chang et al., 2008). Additionally, as mentioned earlier, research has criticized oddity tasks as not true measure children's phonological awareness skills because the tasks involve a memory component (Schatschneider et al., 1999). Other tasks such as sound blending and sound deletion require oral production which may confound the results (Chan et al., 2005). Therefore, the present study followed Wang et al.'s (2005) paradigm of a sound matching task. The child was asked to determine which word shared the same phonological feature with the target one. In Wang et al.'s (2005) study, the target sound was always heard before the other two candidate sounds. In the present study, the target word as be placed in the middle between the two candidate words in order to take advantage of primacy and recency effects, following Best, McRobert and Sithole's (1988) AXB discrimination paradigm. Three stimuli were presented in each trial. The target stimulus (X) was always placed in the middle between the first candidate sound (A) and the third candidate sound (B). For example, a trial for English final phoneme matching contained three sounds (i.e., *lood, perd,* and *chig*). In this example, the sound in the middle, *perd*, was the target stimulus. The two candidate sounds were *lood* and *chig*.

Mandarin Onset-Rime Matching Task. The child was asked to detect a Mandarin monosyllable that carried a different onset or rime from the other two. There were 20 trials of Mandarin monosyllables. Each trial consisted of three monosyllables. One of the candidate monosyllables shared the same onset or rime with the target monosyllable. Ten trials were onset matching and the other 10 trials were rime matching. Onset matching trials were placed in one block and rime matching trials in another. The order of the two blocks was counterbalanced within each group of participants. Monosyllables in each trial carried the same tone. Two nasal sounds in Mandarin, /n/ and /ŋ/, were not compared because it has been suggested that the contrast between /n/ and /ŋ/ has essentially disappeared in the Mandarin spoken in Taiwan, especially in the coda position (Kubler & Ho, 1984, as cited in Zhu, 2002).

Furthermore, unlike the English onset-rime matching task in which pesudowords were used, the Mandarin Onset-Rime Matching task consisted of real Mandarin monosyllables. Pseudowords were used in the English task to reduce the effect of lexical familiarity, which might influence children’s performance. For example, the child may be more likely to pick a familiar word instead of one that matched. Also, as mentioned in Chapter Two, reading experience may lead to an orthographic facilitative effect (Ziegler & Muneaux, 2007). As a result, the child’s familiarity with the spelling of a word could possibly interfere with his or her auditory phonological decisions. Lexical familiarity or orthographic facilitative effects might not be a concern for the Onset-Rime Matching task in Mandarin, however. There are many homophones in Mandarin: There are approximately 420 spoken monosyllables in Mandarin (1300 if tonal variations are taken into account), but there are over 10,000 written Chinese characters. This means that many written Chinese characters share the same pronunciation, and therefore most Mandarin pronunciations are highly familiar. Also, Chinese characters do not directly encode sounds. Therefore, compared to English, lexical familiarity or orthographic facilitative effects for Mandarin monosyllables are less likely to confound the results of phonological judgments. The testing items for the Mandarin Onset-Rime Matching Task can be found in Appendix B.

Mandarin Tone Matching Task. The child was asked to detect a Mandarin monosyllable that had a different tone from the other two. There were a total of 20 trials. The four tones of Mandarin were evenly distributed in the target monosyllables being compared, with each tone appearing five times in the X position. Phonemic content for the three items within a trial was different. Testing items can be found in Appendix C.

English Onset-Rime Matching Task. This task was similar to the Mandarin onset-rime matching task except that the items were English-like pesudowords. The use of English-like pesudowords has been suggested to reduce potential confounding effects of lexical familiarity (Bradley & Bryant, 1983; Gottardo, 2002; Stanovich, Cunningham, & Cramer, 1984) and orthographic facilitation effects, as indicated previously. Following Wang et al.'s (2005) paradigm for this task, monosyllabic pesudowords that conformed to English phonotactic rules were used. Each item consisted of three to five sounds. Following the procedures of designing pseudowords in Snowling (1981), there were four monosyllabic structures: CVC (e.g., *weg*), CVCC (e.g., *zelt*), CCVC (e.g., *steg*), and CCVCC (e.g., *clest*), with each structure appearing five times. Some of the CVC items were the same as those used in Kamhi, Catts, Mauer, Apel, and Gentry (1988). The others were created by the author. The monosyllabic structure in each trial was the same. Ten of the trials were onset matching and the other ten trials were rime matching. Onset matching trials were placed in one block and rime matching trials in another.

The order of the two blocks was counterbalanced within each group of participants. The testing items can be found in Appendix D.

English Final Phoneme Matching Task. The child was asked to report an English-like pesudoword that ended with a different sound from the target stimulus. All words were monosyllabic and contained three to five sounds. The stimulus design procedure was the same as described for the English Onset-Rime Matching task. There were 20 trials, with four different monosyllabic structures (CVC, CVCC, CCVC, and CCVCC) being equally distributed. The testing items can be found in Appendix E.

Administration. All test items were audio-recorded in advance in a quiet setting, using an *Olympus VN-5200 PC Digital Voice Recorder/Player*. A built-in microphone in the recorder was used. The recorder was placed two inches below the speakers' mouth. English items were audio recorded by a female native speaker of English, whereas Chinese items were audio-recorded by the author, a native speaker of Taiwanese Mandarin. All items were played to half of the participants using *an IBM ThinkPad R40 laptop*. Due to a malfunction of this laptop, an *HP Pavilion dv4-1313dx laptop* was used to play sound items to another half of the participants. When listening to the practice trials, I asked each child to tell me if the stimuli were played at a comfortable listening level. If not, the child could ask me to adjust the volume. At the locations where setting up a laptop was not possible, sound items were played via the *Olympus VN-5200 PC Digital Voice Recorder/Player* or were read to the child. For all phonological awareness tasks, the child could ask the author to repeat the audio test items. The child was given three practice trials. Each child received corrective feedback for the practice trials, but not for trials in the actual task.

A metaphor was used to instruct the child in the Mandarin Onset-Rime Matching Task and the Mandarin Tone Matching Task so that he or she could easily associate each item in a trial with a cueing picture. Before playing the sound items to each child, the author showed the child a picture in which a princess stood in between two little girls. The following was the instructional script said to each child in Mandarin:

> *"This pretty princess is going to choose only one of these girls to attend a very special party with her. To decide who could go with her, they played a language game that the princess liked very much. In this language game, each of them will think of one Chinese sound in her mind. Whoever thinks of a Chinese sound similar to the princess's sound will win. Now they need a judge for this game. These three people will individually tell you what sound they have thought of. Then you will decide who has a similar sound to the princess's. Ready to be the judge? Let's do some practices!"*

For the Mandarin Onset-Rime Matching task, the child was told, "Now listen to the beginning/end of the word and judge who has the same beginning/end sound as the princess." For the Mandarin Tone Matching task, the child was told, "Now listen to the tone and judge who has the same tone as the princess."

Similar to the two Mandarin phonological awareness tasks, picture cues were used for the English Onset-Rime Matching Task and the English Final Phoneme Matching Task. Nevertheless, instead of showing only one set of pictures, each item on the English task was represented by one imaginary creature, with the picture in the middle being larger than the other two. The reason was that English-like pesudowords were used for the two English phonological awareness tasks, and they may place a heavier memory load on the child. The child was told that each nonsense word corresponded to each imaginary creature's name. The child was asked to circle which one of the two smaller creatures has a similar name to the big creature's name. For the English Onset-Rime Matching task, the child was told, "Now listen to the beginning/end of the word for the small creature that has a similar name to the bigger one." For the English Final Phoneme Matching task, the child was told, "Now listen to the end of the word for the small creature that has a similar name to the bigger one."

Scoring. One point was given when the child circled the correct answer. The maximum raw score for each phonological awareness task was 20.

Reading tests.

Description and Scoring. Two Chinese reading tests were administered to Taiwanese Mandarin-English speaking bilingual participants. The Graded Chinese Character Recognition was used to determine the bilingual child's Chinese reading ability. Each child was assigned to one of the bilingual subgroups according to his or her performance on this test. If the child scored above the cutoff score which categorized him or her as an Advanced Chinese Reader, the Chinese Reading Comprehension Test was then administered to the child.

Graded Chinese Character Recognition Test. This standardized test contained 200 Chinese characters (Huang, 2001). Characters were listed according to frequency in print and strokes to form the character, from simple to difficult (e.g., 不, 吵, 鏽). The child was asked to read aloud each Chinese character. The author circled the correctly pronounced characters and transcribed errors using Zhu-Yin-Fu-Hao, a phonetic transcription system which Taiwanese children are taught to use, to capture character pronunciation. When the child made 20 consecutive errors, the test was stopped. The scoring procedure in the published test manual was followed. One point was given for every correctly pronounced Chinese character. The maximum score was 200.

Chinese Reading Comprehension Test. To the best of the author's knowledge, the only standardized test that includes a reading comprehension subtest (Hung et al., 1999); however, this test is not culturally appropriate for Taiwanese Mandarin-English bilingual children in the U.S. The reading comprehension passages in the test describe certain cultural events that children in the U.S. may not have experienced. Therefore, a Chinese reading comprehension test was created for the purpose of the present study. Two passages considered as culturally neutral were selected from elementary school language textbooks used in Taiwan. One passage was selected from a Chinese first grade textbook (Lo, 2006a) and the other was selected from a second grade textbook (Lo, 2006b). The author created five comprehension questions for each passage. Both literal and inferential questions were derived from each passage. The child was asked to read the passage and answer the comprehension questions. One point was given for each correct answer. The maximum score was 10. The testing protocol and testing items can be found in Appendix F.

English Word Identification Subtest of the Woodcock Reading Mastery Test-Revised (WRMT-R). This subtest measured children's English word recognition ability (Woodcock, 1987). The child was given 106 real English words ranging from high to low frequency in print (e.g., *sleep, largest, dwarf, prognosis,* and *zeitgeist*). He or she had to read aloud each word. Children's starting items varied according to their current grade level. The test was stopped when the child made six consecutive errors in the last six items of a block. According to the test manual (Woodcock, 1987), each child's raw score was calculated by adding the numbers of correctly pronounced words and the items below the basal. The maximum score was 106.

English Word Attack Subtest of the Woodcock Reading Mastery Test-Revised (WRMT-R). This subtest measured how children decoded English nonwords that conformed to English phonotactic patterns, but were not real words (Woodcock, 1987). There were a total of 45 items varying in complexity (e.g., *dee, pog, sy, vauge,* and *promocher*). Each child started with the first item. The child's task was to pronounce these nonwords. The test was stopped when the child made six consecutive errors in the last six items of a block. A raw score was calculated by adding the correctly pronounced items. The maximum score was 45.

English Passage Comprehension Subtest of the Woodcock Reading Mastery Test-Revised (WRMT-R). The passage comprehension subtest of the WRMT-R is a cloze test. There are of 68 items in all, varying in level of difficulty. Children's starting items varied according to their current grade level. Some items consisted of text and a picture that illustrated meaning of the text, whereas others only contained text. The child was asked to read and comprehend a passage by filling in an omitted word. The child was told that he or she had to supply the most appropriate word to fill in the blank based on his or her understanding of the passage. An example is, "You look through a telescope to see things that are ____ away." According to the test manual (Woodcock, 1987), each child's raw score was calculated by adding the numbers of correct answers and the items below the basal. The maximum score was 68.

Administration of this test was slightly different from the instructions described in the test manual (Woodcock, 1987). According to the test manual, the test should be stopped after a child makes six consecutive incorrect responses that end with the last item in each block. Nevertheless, most participants in the present study felt frustrated before they achieved the ceiling score. As a result, a modified procedure was adapted for the present study. When the child showed signs of frustration, the author would ask the child if he or she would like to try more items. If the child was not willing to do so, the test was stopped.

Oral language proficiency tests. Oral narratives require the child to produce oral language in a naturalistic context. Multiple aspects of language can be examined, for example, syntactic complexity, vocabulary knowledge, and narrative structure (Miller et al., 2006). Therefore, the present study used oral narrative language samples to obtain a global assessment of bilingual children's language proficiency in each language. A wordless picture book, *The Flower Man* (Ludy, 2005), was used to elicit a spontaneous language sample from each child. An experienced librarian working in the children's department in a local public library recommended the use of the book, because it was one of the wordless picture books that young elementary school children enjoyed very much. The book contained a major story of the flower man's journey into a colorless town along with other stories of the flower man's neighbors.

Narrative sample collection. The author collected a narrative sample after a couple of other tests had been administered, in order to establish rapport with the child. The child was first asked if it was okay to record his or her story. Each child first reviewed the book for 5 to 10 minutes. More time was given if necessary. The child was told that he or she would need to tell a story about the flower man and one or two other characters in the book. When the child told a story, the author only listened and showed interest, with nodding or vocal inflection. In some cases, when the child asked how to tell a story or paused for a long time, the author used open-ended questions such as "What do you feel about this place?" or "What happened to this man?" The narrative sample was recorded using an *Olympus VN-5200 PC Digital Voice Recorder/Player*. The built-in microphone in the recorder was used. I held the recorder approximately two inches below the child's mouth. Nevertheless, if the child felt uncomfortable with having a recorder placed below the mouth when telling a story, the recorder was then placed on the table.

All participants generated an English narrative sample. One English narrative and one Mandarin narrative sample were collected from each Taiwanese Mandarin-English speaking participant. The mean length of English narrative samples for all participants was 4 min, 03 sec (n = 58; SD = 2 min, 27 sec). The mean length of Chinese narrative sample was 3 min, 43 sec (n = 29; SD = 2 min, 39 sec).

English narrative sample transcription and analyses. I transcribed all English narrative samples using Systematic Analysis of Language Transcripts (*SALT*; Miller & Iglesias, 2008). Written guidelines for narrative transcription specific to the purpose of the present study were developed by referring to the transcription manual provided in the SALT user guide (Miller & Iglesias, 2008) and an additional language lab transcription manual (Watkins, 2005). See Appendix G for written guidelines for English narrative transcription.

All utterances in each English narrative sample were transcribed and analyzed. Communication Units (C-units) defined by Loban (1976) were used to determine utterance boundaries. C-units consist of an independent clause or an independent clause with all its subordinating clauses (e.g., “When he was standing on a ladder, he fell down”). Each grammatical bound morpheme was marked by using a slash to separate it from the root word. According to SALT transcription convention, mazes refer to reformulations, repetitions, false starts, and filled pauses and were marked in parentheses. Utterances marked as mazes were excluded from analysis.

Three measures were calculated for each English narrative transcript using SALT: Mean Length of Utterance in morphemes (MLU), Total Number of Words (TNW), and Number of Different Words (NDW). MLU was used to indicate a child’s syntactic complexity. English MLU in morphemes was selected instead of MLU in words because it would also reveal information about how Mandarin-English bilingual children use English grammatical morphemes. To measure English proficiency, I considered it more important to assess morphological knowledge than to have parallel measures (i.e., MLU in words) in the two languages. TNW was used as a measure of verbosity, and NDW was used as a measure of vocabulary diversity.

Reliability. Fourteen out of 58 narrative transcripts (approximately 24%) were randomly selected for reliability checks. Two undergraduate research assistants transcribed 14 transcripts (each transcribed seven transcripts individually) without referring to the ones already transcribed by the author. The research assistants were trained to transcribe narrative samples using SALT. Each received approximately 10 hours of individual training by the author. Training included reviewing the SALT user guide and written guidelines for narrative transcription specific developed for the present study (Appendix G), and practicing transcriptions of three narrative samples produced by the Taiwanese Mandarin-English bilingual children whose data were not retained for final analysis. After the research assistants transcribed each practice narrative sample, the author met with each of them to discuss questions regarding SALT conventions and decisions on how to segment utterances and mark morphemes. Both research assistants demonstrated at least 85% transcription reliability on the third practice narrative sample with the author, in terms of utterance segmentation and morpheme marking. The research assistants then began transcribing narrative samples selected for reliability checks.

The author compared her transcripts with those transcribed by the research assistants and calculated two forms of reliability: utterance segmentation and morpheme marking. The mean reliability for utterance segmentation was 91% (ranged from 81% to 96% across the two research assistants). The mean reliability for morpheme marking was 98% (ranged from 96% to 99%

across the two research assistants). Transcription discrepancies were resolved by the author by listening to the narrative samples again and making a final decision.

Mandarin narrative sample transcription and analyses. The author transcribed all Mandarin narrative samples in traditional Chinese characters. Unlike English, Chinese words are traditionally not separated by spaces. Therefore, when transcribing Mandarin narrative samples, the author separated words following Tardif's (1993) guidelines for parts of speech in Mandarin. Mandarin utterances were segmented into C-units following the guidelines for English utterance segmentation. Additional guidelines were developed in order to account for the specific Chinese syntactic structure (e.g., subject omission) or the narrative samples produced by the bilingual children in this study (e.g., code-switching). See Appendix H for additional guidelines for Mandarin narrative sample transcription. Reformulations, repetitions, false starts, and filled pauses were excluded in the analyses.

The Computerized Language Analysis program (CLAN) from the Child Language Data Exchange System (*CHILDES*; MacWhinney, 2000) was used to analyze Mandarin narrative samples. In CLAN, language samples were analyzed by entering appropriate commands onto the command window. To calculate Chinese MLU, the Chinese morphosyntactic analysis program (MOR) was configured in CLAN. The Chinese MOR grammar was built by MacWhinney and Tardif (2000). MLU, TNW, and NDW were calculated for each Mandarin narrative transcript using CLAN.

Reliability. Intrajudge reliability was calculated for Mandarin narrative samples due to the lack of other trained Mandarin transcribers. Intrajudge reliability was evaluated by comparing transcriptions done by the author at two different points in time, separated by a 3-month interval. Six out of 29 Mandarin narrative samples (approximately 20%) were randomly selected for intrajudge reliability checks. The author transcribed the narrative samples without any reference to the transcriptions completed three months earlier. Two forms of intrajudge reliability were calculated: for utterance and word segmentation. The mean reliability for utterance segmentation was 90% (ranged from 88% to 92%). The mean reliability for word segmentation was 95% (ranged from 92% to 98%).

English Title Recognition Test. The English Title Recognition Test was used to measure each child's exposure to print. The title recognition test has been shown to be a measure which significantly accounted for variance in school-age (fourth to sixth grade) children's verbal abilities (Cunningham & Stanovich, 1991). The English Title Recognition Test used for the present study included the titles of chapter books adapted from Cunningham and Stanovich's study (1991) and the titles of picture books selected from The New Read-Aloud Handbook (Trelease, 1989). See Appendix I for the English Title Recognition Test. The reason to include titles of picture books was that the participants in the present study were young school-age children who may not have started reading chapter books yet. In order to evaluate the appropriateness of using a book list developed 18 years ago, I asked the opinions of three librarians working in the children's department at a local public library. Three of them all agreed that the books were classic and still being checked out often by children in the library.

The test included 25 titles of chapter books and 20 titles of picture books. The child was asked to circle the books that he or she had read or had had read to him or her.

Nonverbal intelligence test. The child's nonverbal intelligence was measured with the Test of Nonverbal Intelligence, Third Edition (*TONI-3*, Brown, Sherbenou, & Johnson, 1997). TONI-3 assessed the child's problem-solving skills using abstract figures. There were a total of 45 items. Each item was printed on one page. For each item, there was a stimulus pattern (an abstract pattern or a figure) and several response alternatives. The child's task was to examine the differences and similarities among alternatives and point to a correct response alternative. According to the administration manual, the test was stopped when a child made three incorrect responses in five consecutive items. One point was given for each correct response. Each child's raw score was converted to a quotient according to the norms provided in the test manual.

Language background survey. This survey was adapted from Gutierrez-Clellen and Kreiter's study (2003). It had been used in several bilingual studies to establish children's bilingual status (simultaneous bilingualism vs. sequential bilingualism) or to determine bilingual children's language proficiency level (e.g., Sheng, McGregor, & Marian, 2006). Items 6 to 9 were taken from Kovelman, Baker, and Petitto's study (2008). All survey items can be found in Appendix A.

Procedures

The author administered all measures to each child. The length of data collection varied depending on how quickly each child achieved ceiling scores for standardized reading measures and the nonverbal intelligence test. The entire assessment battery took approximately 2 to 2.5 hours to complete for Taiwanese Mandarin-English Speaking bilingual participants, and 1 to 1.5 hours for Monolingual English-Speaking participants. Three bilingual children completed the assessment battery in two separate sessions, receiving measures in Chinese in one session and in English in the other. The intervals between the two sessions for each child were one day, two days, and one week. The other 37 bilingual children completed the assessment battery in one session. All Monolingual English-Speaking participants finished the assessment battery in one session.

The location of the assessment was based on parental preference, especially when data were collected in other cities. Parents were informed that some measures required tape recording the child or having the child listen to sound clips, so a quiet place would be the best. The locations included the child’s house, a quiet study room or corner in a local library, a classroom or conference room in the Chinese heritage school, a conference room in a private English school, labs in the Speech and Hearing Science Building, and a therapy room in the Speech-Language Pathology Clinic.

The order of administering tests depended on the child’s condition. The general rule was to administer a long test followed by a short test. Each child was given breaks when he or she showed signs of fatigue. Also, each child was given a worksheet which listed the titles of all the measures. After the child finished one measure, he or she selected a stamp from a bag of ten and stamped next to the name of the measure that was completed. Each child had the opportunity to select three to four small gifts at the end of his or her participation. The Language Background Survey was given to the parents at the beginning of the session.

Chapter Four

Results

Overview of Data Analysis

All statistical analyses were conducted using PASW Statistics (formerly SPSS; SPSS. Inc., Version 18.0, 2009). Preliminary data analyses included descriptive analyses and data screening for normality of the distribution of data for each dependent variable by group. The Shapiro-Wilk test was conducted on each dependent variable by group to detect possible departures from normality. Recall that only one participant qualified as a Chinese Advanced Reader. Therefore, the Chinese Advanced Reader group was not included in any of the subsequent statistical analyses.

In order to address all the research questions, two multivariate analyses of variance (MANOVA) were conducted. First, a MANOVA was conducted on an array of Chinese performance variables (i.e., the Mandarin Onset-Rime Awareness task, the Mandarin Tone Awareness task, Chinese TNW, Chinese NDW, and Chinese MLU), to compare the two bilingual subgroups on all of the Chinese measures. Second, a MANOVA was performed on an array of English performance variables (i.e., the English Onset-Rime Awareness task, the English Final Phoneme Awareness task, English TNW, English NDW, English MLU, the English Word Identification, Word Attack, an Passage Comprehension subtests of the WRMT-R) to compare all three groups on all of the English measures. Recall that the Chinese Beginning Reader group had a higher mean nonverbal IQ score than the other two groups, and that the group comparison was nearly significant. Therefore, another two MANCOVAs were conducted using nonverbal IQ as the covariate. The pattern of the group differences found in these two MANCOVAs was the same as that found in the two MANOVAs without using nonverbal IQ as a covariate. Therefore, only the results of the two MANOVAs will be reported in the following sections.

Follow-up univariate analyses of variance (ANOVAs) were used to examine the nature of any group differences. Post hoc tests were conducted using the Tukey HSD procedure if the assumption of equal variance was met. Tamhane's *T*2 procedure was used if the assumption of equal variance was violated. An alpha level of .05 was set for all statistical tests. Effect sizes and observed powers of the MANOVAs and follow-up univariate ANOVAs were reported. Partial eta squared (η_p^2) was used to indicate the effect size in SPSS. Partial eta squared values of .01, .06, and .14 are interpreted as small, medium, and large effect sizes, respectively (Sink & Stroh, 2006). With regard to observed power, a statistical power of .80 is generally considered adequate (Cohen, 1988).

In the following sections, I will first present the results of the two MANOVAs. I will then discuss the specific results to answer each research question. Results regarding the one advanced Chinese reader will then be presented, descriptively. Additionally, a set of multiple regression analyses will be reported. These analyses were performed in light of the results from the two MANOVAs and the bilingual children's demographic information.

MANOVA

MANOVA for the Chinese measures. A between-subjects MANOVA was conducted on an array of Chinese performance variables (i.e., the Mandarin Onset-Rime Awareness task, the Mandarin Tone Awareness task, Chinese TNW, Chinese NDW, and Chinese MLU) to compare performance on all the Chinese measures for the two bilingual subgroups (i.e., the Chinese Beginning Reader and Chinese Nonreader groups). I will first present the descriptive statistics for the Chinese performance variables, followed by the results of the MANOVA.

Descriptive statistics. Descriptive statistics for the Mandarin Onset-Rime and Tone Awareness tasks can be found in Table 9. The maximum score was 20 for each task. The mean score on the Mandarin Onset-Rime Awareness task for both the Chinese Beginning Reader and Chinese Nonreader groups was 18.50 (*SD* = 2.35 and 1.27, respectively). The score range on the Mandarin Onset-Rime Awareness task was 12 to 20 for the Chinese Beginning Reader group and 16 to 20 for the Chinese Nonreader group. As for the Mandarin Tone Awareness task, the Chinese Beginning Reader group had a mean score of 18.05 (*SD* = 2.74) and the Chinese Nonreader group had a mean score of 14.70 (*SD* = 3.09). The score range on the Mandarin Tone Awareness task was 11 to 20 for the Chinese Beginning Reader group. The score range was wider (8 to 20) for the Chinese Nonreader group. Raw scores were converted to percentage correct. Before a MANOVA was conducted, an arcsine transformation was applied to this proportional data. The reason for this was to improve the normality and homogeneity of variance characteristics of the data.

Descriptive statistics for the Chinese number of utterances, TNW, NDW, and MLU can be found in Table 10. Not all bilingual children were able to generate a Mandarin narrative sample. A child who could not tell a story in Mandarin received a score of zero for each measure. Two children in the Chinese Beginning Reader group could not tell a story in Mandarin, and nine in the Chinese Nonreader group could not do so. Raw scores were calculated and used for the MANOVA.

MANOVA statistical assumptions. Two statistical analyses were performed to evaluate whether the data set met the statistical assumptions for MANOVA (i.e., normality and equality of variance-covariance matrices). Data on the Mandarin Onset-Rime Awareness Task and the Mandarin Tone Awareness Task were arcsine transformations of the percentage correct scores.

Data for Chinese TNW, Chinese NDW, and Chinese MLU were raw scores. The Shapiro-Wilk tests for Mandarin TNW in the Chinese Beginning Reader group and the Mandarin Tone Awareness task in the Chinese Nonreader group were not statistically significant (p = .712 and p = .06, respectively), indicating that no normality violations were present. Nevertheless, the Shapiro-Wilk tests for the other dependent variables were significant, indicating possible departure from normality (ps = .001-.038). Box's Test of Equality of Covariance Matrices was not statistically significant (Box's M = 19.937, p = .314), indicating that the dependent variable covariance matrices were equal across groups.

MANOVA results. Using Wilks' criterion, the F-value for groups was statistically significant, Wilks' Lambda $F(5, 34) = 5.794$, $p < .001$, $\eta_p^2 = .46$, observed power = .983, indicating that group differences existed for at least some of the Chinese measures. Follow-up univariate ANOVAs were conducted on each dependent measure separately to determine the nature of the group differences. The results showed that there was a main effect for the Mandarin Tone Awareness task, $F(1, 38) = 14.105$, $p < .001$, $\eta_p^2 = .271$, observed power = .955; Chinese TNW, $F(1, 38) = 7.603$, $p = .009$, $\eta_p^2 = .167$, observed power = .766; Chinese NDW, $F(1, 38) = 8.301$, $p = .006$, $\eta_p^2 = .179$, observed power = .802; and Chinese MLU, $F(1, 38) = 7.189$, $p = .011$, $\eta_p^2 = .159$, observed power = .743. The Chinese Beginning Reader group performed better than the Chinese Nonreader group on all four measures. In sum, comparing the two bilingual groups for the five Chinese measures (i.e., the Mandarin Onset-Rime and Tone Awareness tasks, and Chinese TNW, NDW, and MLU), the results of the MANOVA revealed that the Chinese Beginning Reader group outperformed the Chinese Nonreader group on four of the five measures (i.e., the Mandarin Tone Awareness task, and Chinese TNW, NDW, and MLU).

MANOVA for English measures. A between-subjects MANOVA was conducted on an array of English performance variables (i.e., the English Onset-Rime Awareness task, the English Final Phonemic Awareness task, English TNW, English NDW, English MLU, and the English Word Identification, Word Attack, and Passage Comprehension subtests of the WRMT-R), to compare the performance of all three groups (i.e., the Chinese Beginning Reader, Chinese Nonreader, and English Monolingual groups) on all of the English measures. I will first present the descriptive statistics for the English performance variables, followed by the results of the MANOVA.

Descriptive statistics. The descriptive statistics for the English Onset-Rime Awareness and English Final Phoneme Awareness tasks can be found in Table 11. The maximum raw score for each task was 20. Again, the raw scores for English phonological awareness were converted to percentage correct. Before a MANOVA was conducted, an arcsine transformation was applied to this proportional data.

Table 12 is a display of means, standard deviations, and ranges for TNW, NDW, and MLU--in addition to the number of utterances--for English oral language proficiency. Raw scores were used for the MANOVA.

In terms of English reading ability, English Word Identification, Word Attack and Passage Comprehension subtests of the WRMT-R were administered to each participant in all groups. The maximum raw scores for each subtest were 106, 45, and 68, respectively. Table 13 is a display of means, standard deviations, and ranges for each group. Raw scores were used in the MANOVA.

For the English MANOVA, some data were missing in the Chinese Beginning Reader and Chinese Nonreader groups. In particular, the data for English TNW, English NDW, and

English MLU were missing for one child in each group. The Chinese Beginning reader did not want to tell a story in English and the Chinese Nonreader was not willing to be audio-recorded. The data for the English Word Identification, English Word Attack, and English Passage Comprehension subtests were missing for another child in the Chinese Nonreader group. This child's parents were not able to schedule another session for him to complete these English subtests. The missing data for each dependent variable did not exceed 5% of the entire sample. Also, according to criteria suggested by Allison (2002, as cited in Meyers, Gamst, & Guarino, 2006), these missing data points were missing at random (MAR) because they were not related to the group assignment. As a result, pairwise deletion was considered an appropriate approach to process missing data in this MANOVA. In SPSS, pairwise deletion means that when a case (i.e., a child) contained missing data for some variables, other variables that contained valid values were still included in the analysis.

MANOVA statistical assumptions. Two statistical analyses were performed to evaluate whether the data set met the statistical assumptions for MANOVA (i.e., normality and equality of variance-covariance matrices). Data on the English Onset-Rime Awareness task and the English Final Phonemic Awareness task were arcsine transformations of the percent correct scores. Data for English TNW, English NDW, and English MLU, and the English Word Identification, Word Attack, and Passage Comprehension subtests were raw scores. The Shapiro-Wilk tests were statistically significant (ps = .001-.03) for the English Onset-Rime Awareness task, in all three groups; the English Final Phoneme Awareness task, in the Chinese Beginning Reader and the Chinese Nonreader groups; and English TNW and NDW, in the English Monolingual group; indicating possible departure from normality. The Shapiro-Wilk tests on the other dependent variables were not significant (p = .07-.85), indicating that the assumption of normality was not violated. Box's Test of Equality of Covariance Matrices was also statistically significant (Box's $M = 135.744$, $p < .006$), indicating that covariance matrices for the dependent variables were not equal across groups. Therefore, Pillai's Trace in assessing the multivariate effect was used instead of Wilks' criterion.

MANOVA results. Using Pillai's Trace, the *F*-value for groups was statistically significant, Pillai's Trace $F(16, 96) = 2.984$, $p < .001$, $\eta_p^2 = .332$, observed power = .996, indicating that group differences existed for at least some of the English measures. Follow-up univariate ANOVAs were conducted on each dependent variable separately to determine the nature of group differences. The results showed that there was a main effect for the English Final Phoneme Awareness task, $F(2, 54) = 9.922$, $p < .001$, $\eta_p^2 = .269$, observed power = .979; English TNW, $F(2, 54) = 5.331$, $p = .008$, $\eta_p^2 = .165$, observed power = .819; English NDW, $F(2, 54) = 4.013$, $p = .024$, $\eta_p^2 = .129$, observed power = .693; and the English Word Attack subtest, $F(2, 54) = 8.609$, $p < .001$, $\eta_p^2 = .242$, observed power = .960.

Post hoc tests were conducted using the Tukey HSD procedure if the assumption of equal variance was met. Tamhane's *T*2 procedure was used if the assumption of equal variance was violated. According to Levene's Test of Equality of Error Variances, the error variance of English TNW ($p = .037$) and the English Word Attack subtest ($p < .001$) was not equal across groups, so Tamhane's *T*2 procedure was used to conduct post hoc tests for these two variables. The results showed that the Chinese Beginning Reader group obtained significantly higher scores on the English Final Phoneme Awareness task than the Chinese Nonreader group, $p = .021$, and the English Monolingual group, $p <.001$. Moreover, the English Monolingual group had higher scores for English TNW ($p = .041$) and NDW ($p = .038$) than the Chinese Nonreader group. Lastly, the Chinese Beginning Reader group obtained higher scores on the English Word Attack subtest than both the Chinese Nonreader group, p = .024, and the English monolingual group, p <.001. In sum, for English measures, the Chinese Beginning Reader group outperformed the Chinese Nonreader and English Monolingual groups on the English Final Phoneme Awareness task and the English Word Attack subtest. The English Monolingual group outperformed the Chinese Nonreader group for English TNW and NDW.

Results for Research Question 1: Phonological Awareness

Research Question 1 asked whether Taiwanese Mandarin-English bilingual children's phonological awareness skills in both languages would differ as a function of their level of Chinese reading ability. I predicted that the Chinese Beginning Reader group would perform better than the Chinese Nonreader group on all Mandarin and English phonological awareness measures.

Consistent with my predictions, the results from the Chinese MANOVA revealed that there was a group difference for the Mandarin Tone Awareness task, with the Chinese Beginning Reader group performing better than the Chinese Nonreader group. Also, results from the English MANOVA revealed that there was a group difference for the English Final Phoneme Awareness task, with the Chinese Beginning Reader group obtaining higher scores than the Chinese Nonreader group. Nevertheless, contrary to predictions, there were no group differences for the Mandarin Onset-Rime Awareness, $F(1, 38) = .465$, $p = .499$, observed power = .10, and English Onset-Rime Awareness tasks, $F(2, 54) = 1.411$, $p = .253$, observed power = .29. In sum, the results partially confirmed my hypothesis: Group differences were found for only one of the phonological awareness tasks in each language, (i.e., Mandarin tone and English final phoneme awareness), with the Chinese Beginning Reader group performing better on these two tasks.

Results for Research Question 2: Oral Language Proficiency

Research Question 2 asked whether Taiwanese Mandarin-English bilingual children's oral language skills in both languages would differ as a function of their level of Chinese reading ability. I predicted that the Chinese Beginning Reader group and the Chinese Nonreader group would perform the same on all Chinese and English oral language measures. I hypothesized that only the Chinese Advanced Reader group would achieve the threshold in Chinese reading ability necessary for enhanced, more literate oral language abilities.

The results from the Chinese MANOVA revealed that there were group differences for all Chinese measure of oral language proficiency: Chinese TNW, Chinese NDW, and Chinese MLU. For these three measures, the Chinese Beginning Reader group performed better than the Chinese Nonreader group. Results for the English MANOVA revealed no significant group differences for the two bilingual groups for any English oral language measures: English TNW (p = .987), English NDW (p = .974), and English MLU (p = .369).

In sum, the results for the oral language proficiency in Chinese did not confirm my hypothesis. The Chinese Beginning Reader group outperformed the Chinese Nonreader group on all three Chinese measures of oral language proficiency. The results for oral language proficiency in English were consistent with my hypothesis, with the two bilingual groups performing similarly on all three English measures of oral language proficiency.

Results for Research Question 3: English Reading

Research Question 3 asked whether Taiwanese Mandarin-English bilingual children's English reading skills would differ as a function of their level of Chinese reading ability. I predicted that the Chinese Beginning Reader and Chinese Nonreader groups would perform the same on all of the English reading subtests. Again, I hypothesized that only the Chinese Advanced Reader group would read enough Chinese to benefit English reading achievement.

Results from the MANOVA showed that the two groups did not differ on the English Word Identification, $F(2, 54) = 1.117$, $p = .335$, observed power = .236, and Passage Comprehension subtests of the WRMT-R, $F(2, 54) = 2.713$, $p = .075$, observed power = .515. Unexpectedly, the two groups performed differently on the English Word Attack subtest, with the Chinese Beginning Reader group obtaining higher scores than the Chinese Nonreader group. In sum, the results for English reading skills partially confirmed my hypothesis.

Results for Research Question 4: Comparing Three Groups on the English Measures

Research Question 4 asked whether each Mandarin-English bilingual subgroup differed from the monolingual English-speaking group in English phonological awareness, oral language proficiency, and reading skills. In terms of English Phonological Awareness, I predicted that the Chinese Beginning Reader group would perform better than both the Chinese Nonreader and English monolingual groups. In terms of English oral language and reading skills, I predicted that there would be no group differences except for the Chinese Advanced Reader group (i.e., only for this group would Chinese reading be high enough to benefit their oral language proficiency and literacy in English).

For English phonological awareness, the results from the English MANOVA revealed that, as predicted, there were significant group differences for the English Final Phoneme Awareness task. Contrary to my prediction, however, the three groups did not differ on the English Onset-Rime Awareness task, $F(2, 54) = 1.411$, $p = .253$, observed power = .290. For English oral language proficiency, the results revealed that, as predicted, the three groups did not differ on English MLU, $F(2, 54) = 2.558$, $p = .087$, observed power = .49. Contrary to my predictions, there were significant group differences in English TNW and English NDW. For English reading skills, as predicted, there were no groups differences for the English Word Identification, $F(2, 54) = 1.117$, $p = .335$, observed power = .236, and Passage Comprehension subtests, $F(2, 54) = 2.713$, $p = .075$, observed power = .515. Contrary to my prediction, however, the three groups differed on the English Word Attack subtest.

Specifically, post hoc tests revealed that, as predicted, the Chinese Beginning Reader group obtained higher scores on the English Final Phoneme Awareness task than the English monolingual group. Contrary to predictions, however, the English Monolingual group had higher scores for English TNW and English NDW than the Chinese Nonreader group. Also, contrary to predictions, the Chinese Beginning Reader group obtained higher scores on the English Word Attack subtest of the WRMT-R than both the Chinese Nonreader and the English monolingual groups.

Descriptive Results for the Chinese Advanced Reader

As already mentioned in Chapter 3, only one child met the criteria for the Chinese Advanced Reader group. The child scored 80 out of 200 on the Graded Chinese Character Recognition Test (Huang, 2001). Also, she was able to read the passages in the Chinese Reading Comprehension Test fluently and obtained a perfect Chinese reading comprehension score.

See Table 4 for the child's age, gender, SES, and nonverbal intelligence as compared to the means for those in the other three groups. As can be seen from the table, the child was younger than all of the mean ages (M = 102.50-104.25) for the other three groups. Her family's social index was higher than the means for the other three groups (M = 50.35-54.34). She also obtained higher scores on the Nonverbal Intelligence Test compared with the means of the other three groups (M = 109.50-119.15), scoring 2 standard deviations above the mean for the test.

See Table 5 for information of the child's English language and literacy background. She was exposed to English prior to the age of three, as were most of the other participants. She had received approximately four years of formal English literacy instruction, which was similar to the means for the other groups. Her parents read with her in English at home. She scored 6 on the English Title Recognition Test (Picture Books), which was below the means for the other groups (M = 7.10-8.50 books). Nevertheless, she scored 6 books on the English Title Recognition Test (Chapter Books), which was higher than the means for the other three groups (M = 3.10-3.90).

See Table 6 for the child's Chinese language and literacy background information in comparison with the other three groups. Approximately 35% of input she received and approximately 35% of the output she produced in her daily life was in Chinese. The amount of her Chinese input and output was between that in the Chinese Beginning Reader group (M = 39%) and the Chinese Nonreader group (M = 18%). Her parents rated her English proficiency as a 4 and Chinese proficiency as a 3. She had received approximately four years of formal Chinese literacy instruction, which was longer than the means for the Chinese Beginning Reader group (M = 3.62 years) and the Chinese Nonreader group (M = 2.50 years). Her parents read with her at home in Chinese.

As can be seen from Tables 9 and 11, the child received perfect scores for all the phonological awareness measures. Figures 1 to 4 are the box plots of children's performance on the four phonological awareness tasks. The Chinese Advanced Reader's performance is indicated by the black solid dots. As can be seen from the figures, her performance on the four phonological awareness tasks were within the range of those for the other groups.

See Tables 10 and 12 for the Chinese Advanced Reader's scores on the Chinese and English oral language proficiency measures. She produced 25 Chinese utterances, 285 words for the Chinese TNW measure, and 86 words for the Chinese NDW measure. Her Chinese MLU was 11.40 words. Except for the number of Chinese utterances, her scores on Chinese TNW, NDW, and MLU were higher than the means of the other two bilingual subgroups. In terms of English oral language proficiency, she produced 28 English utterances, 318 words for the English TNW measure, and 109 words for the English NDW measure. Her English MLU was 11.29 morphemes. Her number of English utterance was fewer than the means in the other three groups. Also, her English TNW and NDW were fewer than the means for the English monolingual group, but more than for the two bilingual subgroups. Her English MLU was higher than the means for the other three groups.

Figures 5 to 10 are box plots of children's performance on the oral language proficiency measures. The Chinese Advanced Reader's scores are indicated by the solid black dots. As can be seen from these figures, the child's performance on Chinese TNW, Chinese NDW, English TNW, and English NDW were within the ranges of the other groups. Nevertheless, her Chinese MLU was above the range for the other two bilingual groups (see Figure 7) and her English MLU was above the range for the Chinese Nonreader and English Monolingual groups (see Figure 10).

See Table 13 for the Chinese Advanced Reader's performance on the English reading subtests. She scored 91, 43, and 43 on the English Word Identification, Word Attack, and the Passage Comprehension subtests of the WRMT-R, respectively. All of her English reading scores were higher than the means for the other three groups. Figures 11 to 13 are box plots of all three groups' performance on the three English reading subtests. As can be seen from these figures, her performance was within the ranges for all of the groups.

Additional Analyses: Multiple Regressions

The Chinese and English MANOVAs revealed that the two bilingual groups differed significantly in Mandarin Tone Awareness, English Final Phoneme Awareness, Chinese TNW, Chinese NDW, Chinese MLU, and the English Word Attack subtests of the WRMT-R. Recall that the two bilingual groups were established on the basis of their differing levels of Chinese character reading. As a result, the significant findings of the two MANOVAs seem to suggest that bilingual children's Mandarin and English phonological awareness, Chinese oral language ability, and English word attack ability are related to their Chinese character reading ability. Nevertheless, according to the results presented in Chapter Three, the two bilingual groups also differed on four demographic measures. In particular, the two bilingual groups differed in amount of language input and output in Chinese, years of receiving formal Chinese literacy instruction, and whether parents read with the child in Chinese at home. Also, the comparison of nonverbal intelligence was nearly statistically significant (p = .062). Therefore, in addition to Chinese character reading ability, these four demographic variables and nonverbal intelligence may be related to bilingual children's performance on Mandarin Tone Awareness, English Final Phoneme Awareness, Chinese TNW, Chinese NDW, Chinese MLU, and the English Word Attack subtest. In order to further examine whether Chinese character reading would contribute a unique amount of variance to these outcome variables, independent of the demographic variables and nonverbal intelligence, a set of multiple regression analyses was conducted. Among the four demographic variables, *whether parents read with the child in Chinese at home* was excluded from the analyses because it was not a continuous variable. Therefore, three demographic variables along with nonverbal IQ and certain performance measures were included in the multiple regression analyses. Only bilingual participants were included and the two bilingual groups were combined in the analyses.

Mandarin tone awareness. The Chinese MANOVA indicated that the two bilingual groups performed differently on the Mandarin Tone Awareness task. Recall that Research Question 1 predicted that Chinese character reading ability would influence bilingual children's English and Mandarin phonological awareness. Therefore, a set of multiple regression analyses was conducted to determine whether Chinese character reading would account for a unique amount of variance in Mandarin tone awareness, independent of other variables. First, a stepwise multiple regression was performed to identify the best demographic or performance predictor(s) of Mandarin tone awareness. The reason of performing a stepwise regression as a first step was to narrow down the number of variables of interest. This method would improve the power of the regression analyses (Wang et al., 2005). This reasoning applies as well to the stepwise regression analyses presented in the following sections. The stepwise regression was also used to reveal which combination of variables would provide the best prediction of phonological awareness performance. Second, a hierarchical multiple regression analysis was performed to determine whether Chinese character reading ability would account for a unique amount of variance, beyond that accounted for by the demographic or performance variables identified in the stepwise multiple regression analysis.

Stepwise regression. In identifying the best predictors of Mandarin tone awareness, five variables (i.e., nonverbal IQ, Chinese input and output, years of receiving Chinese literacy instruction, and the Chinese oral language proficiency composite score) were entered in the stepwise regression analysis. The Chinese oral language proficiency composite score was included in addition to nonverbal IQ and the three demographic variables, because of the close relation between oral language and phonological awareness. The composite score was formed by first calculating *z*-scores for Chinese TNW, NDW, and MLU, based on the sample mean and standard deviation. The Chinese composite score was the sum of the *z*-scores for Chinese TNW, NDW, and MLU, and represents a performance, rather than demographic variable.

The results of the stepwise regression revealed that Chinese input and output (p = .78 and p = .98, respectively), years of receiving Chinese literacy instruction (p = .87), and the Chinese oral language proficiency composite score (p = .43) were excluded from the equation, because they did not have a statistically significant impact on the model's ability to predict Mandarin tone awareness. The equation that included nonverbal IQ was statistically significant, $F(1, 37)$ = 7.418, p < .01, R^2 = .167, adjusted R^2 = .145. Based on this result, nonverbal IQ was considered a significant predictor of Mandarin tone awareness and was thus retained for the following hierarchical regression analysis.

Hierarchical regression. To determine whether Chinese character reading ability would account for a unique amount of variance for Mandarin tone awareness, beyond the variance accounted for by nonverbal IQ, a hierarchical regression was conducted. Chinese character reading ability and nonverbal IQ were the predictor variables and Mandarin tone awareness was the dependent variable. Chinese character reading and nonverbal IQ were entered in two alternative orders into the hierarchical multiple regression equation (see Table 14). When nonverbal IQ was entered first, the results showed that Chinese character reading ability still contributed a statistically significant amount of variance (approximately 15%, the value of adjusted R^2 change converted to a percentage) to Mandarin tone awareness, $\Delta F(1, 36)$ = 8.673, p = .006, ΔR^2 = .162, adjusted R^2 change (the adjusted R^2 in Block 2 minus the adjusted R^2 in Block 1) = .146. For the second order, when Chinese character reading was entered first, nonverbal IQ no longer accounted for a statistically significant amount of variance in the scores of Mandarin tone awareness, $\Delta F(1, 36) = 3.424$, $p = .072$, $\Delta R^2 = .064$. These results indicated that Chinese character reading accounted for a unique amount of variance in Mandarin tone awareness after nonverbal IQ was controlled.

Prediction of Chinese character reading from Mandarin tone awareness. Due to the concurrent relation between phonological awareness and word level reading, it was also of interest to explore whether Mandarin tone awareness would account for a statistically significant proportion of the variance in the scores for Chinese character reading. Therefore, another set of multiple regression analyses was conducted to explore the directionality of the relation between Chinese character reading and Mandarin tone awareness. Mandarin tone awareness was considered the predictor variable in the analyses and Chinese character reading ability was the dependent variable. First, a stepwise regression analysis showed that years of receiving formal Chinese literacy instruction was the best demographic predictor of Chinese character reading, among the five prediction variables (i.e., Chinese input, Chinese output, years of receiving formal Chinese literacy instruction, nonverbal IQ, and the Chinese oral language proficiency composite score), $F(1, 37) = 7.418$, $p = .015$, $R^2 = .150$, adjusted $R^2 = .127$. Therefore, years of receiving formal Chinese literacy instruction and Mandarin tone awareness were entered in the hierarchical regression analysis. The results of the hierarchical multiple regression (see Table 15) revealed that Mandarin tone awareness (entered as Block 2) contributed a statistically significant amount of variance (approximately 18%, the value of adjusted R^2 change converted to a percentage) to Chinese character reading after years of receiving Chinese literacy instruction (entered as Block 1) was taken into consideration, $\Delta F(1, 36) = 10.89$, $p = .002$, $\Delta R^2 = .197$, adjusted R^2 change = .184. This result indicated that Mandarin tone awareness accounted for a unique amount of variance in the scores of Chinese character reading.

Taken together, the results of the two hierarchical regression analyses indicated that Chinese character reading accounted for approximately 15% of the unique variance in the scores for Mandarin tone awareness. Mandarin tone awareness also accounted for approximately 18% of unique variance for Chinese character reading. These results suggest that relation between Chinese character reading and Mandarin tone awareness is bidirectional.

English final phoneme awareness. The English MANOVA revealed that the two bilingual groups performed differently on the English Final Phoneme Awareness task. To determine whether Chinese character reading would still account for a unique amount of variance in English final phoneme awareness, independent of other variables, a set of multiple regressions was conducted. A stepwise regression analysis was performed as first followed by a hierarchical regression analysis.

Stepwise regression. First, to identify the best demographic or performance predictor(s) of English final phoneme awareness or combination of predictors, English final phoneme awareness was regressed on six variables (i.e., nonverbal IQ, Chinese input and output, years of receiving Chinese literacy instruction, the Chinese oral language proficiency composite score, and the English Word Attack subtest of the WRMT-R). In addition to nonverbal IQ and the three demographic variables, the Chinese oral language proficiency composite score and the English Word Attack subtest were included because the two bilingual groups also performed differently on these two tasks, both of which have been found to be closely related to phonological awareness. The results of the stepwise regression analysis showed that IQ (p = .95), Chinese output (p = .82), the Chinese oral language proficiency composite score (p = .84), and the

English Word Attack subtest (p = .51) were excluded from the equation, because they did not have a statistically significant impact on the model's ability to predict English final phoneme awareness. The final equation included years of receiving Chinese literacy instruction and Chinese input. The overall equation was statistically significant, $F(2, 35) = 5.32$, $p = .01$, $R^2 = .233$, adjusted $R^2 = .189$. Therefore, years of receiving Chinese literacy instruction and Chinese input together accounted for approximately 19% (the value of adjusted R^2 converted to a percentage) of the variance in the scores on the English Final Phoneme Awareness task. In particular, years of receiving Chinese literacy instruction accounted for approximately 11% of the variance in the scores on the English Final Phoneme Awareness task, $\Delta F(1, 36) = 5.38$, $p = .026$, $\Delta R^2 = .130$, adjusted R^2change = .106. Chinese input accounted for an additional 8% of the variance in the scores on the task, $\Delta F(1, 35) = 4.708$, $p = .037$, $\Delta R^2 = .103$, adjusted R^2 change = .083. Based on these results, years of receiving Chinese literacy instruction and Chinese input were considered significant variables that might have contributed to bilingual children's performance on the English Final Phoneme Awareness task and were thus used for the following regression analysis.

Hierarchical regression. A hierarchical multiple regression analysis (see Table 16) showed that Chinese character reading ability (entered as Block 1) did not predict a statistically significant amount of unique variance in the scores for English final phoneme awareness after years of receiving Chinese literacy instruction and Chinese input (entered as Block 2) were taken into consideration, $\Delta F(1, 36) = .820$, $p = .371$, $\Delta R^2 = .017$. Nevertheless, when Chinese character reading was entered as Block 1, it accounted for approximately 8.6% of the variance in the scores of English Final Phoneme Awareness, $\Delta F(1, 38) = 4.688$, $p = .037$, $\Delta R^2 = .11$, adjusted $R^2 = .086$. In this case, years of receiving Chinese literacy instruction and Chinese input together (entered as Block 2) still accounted for a statistically significant amount of variance (approximately 10%) in the scores for English final phoneme awareness, $\Delta F(2, 36) = 3.37$, $p = .045$, $\Delta R^2 = .14$, adjusted R^2 change = .102. These results suggest that in predicting bilingual children's English final phoneme awareness, Chinese character reading may overlap with years of receiving Chinese literacy instruction and Chinese input.

Chinese oral language proficiency. The Chinese MANOVA indicated that the two bilingual groups performed differently on all three measures of Chinese oral language proficiency. Recall that Research Question 2 predicted that Chinese character reading ability would influence bilingual children's Chinese oral language proficiency. Given that the two bilingual groups also differed on the three demographic measures and nonverbal IQ as previously mentioned, it is necessary to determine whether Chinese character reading would still account for a unique amount of variance in Chinese oral language proficiency, independent of these variables. A set of multiple regressions was then conducted.

Stepwise regression. To identify the best demographic or performance predictor(s) of Chinese oral language proficiency or combination of predictors, the Chinese oral language proficiency composite score was regressed on five variables (i.e., nonverbal IQ, Chinese input and output, years of receiving Chinese literacy instruction, and the Mandarin phonological awareness composite score). The Mandarin phonological awareness composite score was the sum of the z-scores for Mandarin onset-rime and Mandarin tone awareness. Given the close relation between oral language and phonological awareness, the Mandarin phonological awareness composite score was included as one of the predictor variables in the stepwise regression analysis. The results of the stepwise regression analysis revealed that nonverbal IQ ($p = .54$), Chinese input ($p = .75$), years of receiving Chinese literacy instruction ($p = .35$), and the

Mandarin phonological awareness composite score (p = .39) were excluded from the equation, because they did not have a statistically significant impact on the model's ability to predict Chinese oral language proficiency. The final equation that included Chinese output was statistically significant, $F(1, 37) = 40.294$, $p < .001$, $R^2 = .521$, adjusted $R^2 = .508$. This result suggested that Chinese output was a significant variable that might contribute to bilingual children's Chinese oral language proficiency. Therefore, Chinese output was included in the following hierarchical regression analysis.

Hierarchical regression. To determine whether Chinese character reading would account for a unique amount of variance in Chinese oral language proficiency, beyond the variance accounted for by Chinese output, a hierarchical regression analysis was performed. The results of the hierarchical multiple regression analysis (see Table 17) revealed that Chinese character reading did not account for a statistically significant amount of variance in Chinese oral language proficiency (entered as Block 2) after Chinese output (entered as Block 1) was taken into consideration, $\Delta F(1, 37) = .761$, $p = .388$, $\Delta R^2 = .01$. When Chinese character reading was entered first (as Block 1) into the equation, it did not account for a statistically significant amount of variance in Chinese oral language proficiency. In this case, however, Chinese output (when entered as Block 2) still accounted for a statistically significant amount of variance (approximately 44%) in Chinese oral language proficiency, $\Delta F(1, 37) = 34.577$, $p < .001$, $\Delta R^2 = .438$, adjusted R^2 change = .437. These results suggested that Chinese character reading was not a significant predictor of Chinese oral language proficiency. Instead, the relation between Chinese output and Chinese oral language proficiency was much stronger.

The English Word Attack subtest. The English MANOVA revealed that the two bilingual groups performed differently on the English Word Attack subtest of the WRMT-R.

Recall that Research Question 3 predicted that bilingual children's Chinese character reading ability would influence their English reading ability. Nevertheless, because the two bilingual groups also differed on the three demographic measures and nonverbal IQ, it is important to determine whether Chinese character reading would still account for a unique amount of variance in the scores on the English Word Attack subtest. A set of multiple regression analyses was conducted to explore this relation.

Stepwise regression. To identify best demographic or performance predictor(s) of English word attack ability, the English Word Attack subtest was regressed on six predictor variables (i.e., nonverbal IQ, Chinese input and output, years of receiving Chinese literacy instruction, the English phonological awareness composite score, and the Mandarin phonological awareness composite score). The English phonological awareness composite score was the sum of the *z*-scores for the English onset-rime and final phoneme awareness tasks. One of the skills required for children to perform on the English Word Attack subtest is phonological awareness. Therefore, both English and Mandarin phonological awareness were considered as predictor variables. The results revealed that Chinese input ($p = .56$), years of receiving Chinese literacy instruction ($p = .78$), and the English phonological awareness composite score ($p = .92$) were excluded from the equation, because they did not have a statistically significant impact on the model's ability to predict bilingual children's English Word Attack ability. The final equation included nonverbal IQ, the Mandarin phonological awareness composite score, and Chinese output. The overall equation was statistically significant, $F(3, 34) = 8.23$, $p < .001$, $R^2 = .42$, adjusted $R^2 = .37$. Therefore, nonverbal IQ, Mandarin phonological awareness, and Chinese output together accounted for approximately 37% of the variance in the scores on the English Word Attack subtest. In particular, IQ accounted for approximately 19% of the variance, ΔF(1,

36) = 9.73, $p = .004$, $\Delta R^2 = .213$, adjusted R^2change = .191. Chinese output accounted for an additional 11% of the variance, $\Delta F(1, 35) = 6.559$, $p = .015$, $\Delta R^2 = .124$, adjusted R^2 change = .108. Mandarin phonological awareness accounted for yet an additional 7% of the variance, $\Delta F(1, 34) = 4.904$, $p = .034$, $\Delta R^2 = .084$, adjusted R^2 change = .071. Based on these results, nonverbal IQ, Mandarin phonological awareness, and Chinese output were considered significant predictors of English word attack and were thus included in the following hierarchical regression analysis.

Hierarchical regression. To determine whether Chinese character reading would account for a unique amount of variance in the scores on the English Word Attack subtest, independent of nonverbal IQ, Mandarin phonological awareness, and Chinese output, a hierarchical multiple regression analysis was conducted. The results (see Table 18) revealed that Chinese character reading (entered as Block 2) did not account for a statistically significant amount of variance in bilingual children's English word attack ability after nonverbal IQ, Mandarin phonological awareness, and Chinese output (entered as Block 1) were taken into consideration, $\Delta F(1, 33) = .595$, $p = .446$, $\Delta R^2 = .01$. When Chinese character reading was entered first into the equation (as Block 1), however, it accounted for approximately 17% of the variance in bilingual children's English word attack ability, $\Delta F(1, 36) = 8.752$, $p = .005$, $\Delta R^2 = .196$, adjusted $R^2 = .173$. Also, in this case, IQ, Mandarin phonological awareness and Chinese output together still accounted for a statistically significant amount of variance in bilingual children's English word attack ability, $\Delta F(1, 37) = 4.55$, $p = .009$, $\Delta R^2 = .235$, the adjusted R^2 change = .189. These results suggested that in predicting bilingual children's English word attack ability, Chinese character reading may overlap with nonverbal IQ, Mandarin phonological awareness, and Chinese output.

Chapter Five

Discussion

Overview

The present study aimed to examine biliteracy effects on Taiwanese Mandarin-English bilingual children's phonological awareness, oral language skills, and English reading ability. Performance of two subgroups of second- and third-grade Mandarin-English bilingual children who had achieved different levels of Chinese character recognition ability was compared. In addition, the two bilingual subgroups were compared with a group of English monolingual children. Each child was assessed in three domains of language and reading related skills: phonological awareness, oral language proficiency, and English reading. Three major findings emerged from this study. First, bilingual Chinese Beginning Readers outperformed bilingual Chinese Nonreaders on the Mandarin Tone Awareness task and English Final Phonemic Awareness task. Bilingual Chinese Beginning Readers also performed better than the English Monolingual group on the English Final Phoneme Awareness task. Second, in terms of oral language proficiency, bilingual Chinese Beginning Readers received higher scores on Chinese TNW, NDW, and MLU than bilingual Chinese Nonreaders. The English Monolingual group performed better than bilingual Chinese Nonreaders on English TNW and English NDW. Third, bilingual Chinese Beginning readers demonstrated better English nonword decoding ability -- as measured by the English Word Attack subtest of WRMT-R -- than both bilingual Chinese Nonreader and English Monolingual groups. In the following sections, results pertaining to each research question will be discussed. Discussion for Research Question 4 will be integrated with that for Research Questions 1 to 3. Descriptive data for the single Chinese Advanced Reader will be discussed in a separate section.

Research Questions 1 and 4: Phonological Awareness

Research Question 1 asked whether Taiwanese Mandarin-English bilingual children's phonological awareness skills would differ as a function of their level of Chinese reading ability. I originally hypothesized that a graded effect for English and Mandarin phonological awareness would be observed in three bilingual groups (i.e., the Chinese Advanced Reader, the Chinese Beginning Reader, and the Chinese Nonreader groups), with the Chinese Advanced Reader group performing better than the Chinese Beginning Reader group, which in turn would perform better than the Chinese Nonreader group. With respect to the comparison of the bilingual groups to the English monolingual group, Research Question 4 hypothesized that English monolingual children would perform similarly in English phonological awareness to the Chinese Nonreader group, because the two groups were learning to read only one writing system. In other words, the Chinese Advanced Reader group would outperform the Chinese Beginning Reader group, which in turn would outperform both the Chinese Nonreader and English Monolingual groups in English phonological awareness. The results of the present study partially supported my hypotheses. The graded effect of Chinese character reading on phonological awareness was observed despite the lack of a Chinese Advanced Reader group. Specifically, the Chinese Beginning Reader group performed better than the Chinese Nonreader group on the Mandarin Tone Awareness and English Final Phoneme Awareness tasks. The Chinese Beginning Reader group also outperformed the English monolingual group on the English Final Phoneme Awareness task. Contrary to my prediction, there were no group differences for the Onset-Rime Awareness and Onset-Rime Awareness tasks, either in Mandarin or English.

By definition, the two bilingual groups differed in their level of Chinese character reading ability. The different group performance on the Mandarin Tone Awareness task seems to suggest that the Chinese Beginning Reader group's higher level of Chinese character reading ability contributed to a heightened awareness of Mandarin tones. Nevertheless, additional regression analyses indicated that the relation between Chinese character reading ability and Mandarin tone awareness is bidirectional. Chinese character reading accounted for a significant amount of variance (15%) in Mandarin-tone awareness after IQ was taken into consideration. Conversely, Mandarin tone awareness accounted for a comparable amount of variance (approximately 18%) in Chinese character reading after another demographic variable (i.e., years of receiving formal Chinese literacy instruction) was taken into consideration. As a result, there appear to be two viable explanations. First, attaining a higher level of Chinese character reading ability seems to boost bilingual children's Mandarin tone awareness. Second, better Mandarin tone awareness allows bilingual children to attain a higher level of Chinese character reading ability.

Tone is a suprasegmental feature of spoken Chinese and is not visually encoded in written Chinese. In Mandarin Chinese, there are four tones: high, rising, dipping, and falling. (In contrast, there are nine tones in Cantonese but only six distinctive tones are used in many transcription systems.) The present study showed that although tone is not a feature visually encoded in written Chinese, it still has a close relation with children's Chinese character reading ability. A possible explanation could be attributed to the important lexical function of tone in Chinese. As mentioned previously, Chinese has a limited number of syllables (approximately 400). Tone distinguishes meanings across Chinese characters and thus reduces a large number of homophones in Chinese. For example, the very same syllable /ma/ can carry four different meanings when four different tones are attached to it: /ma1/ 媽 (mother), /ma2/ 麻 (numb), /ma3/ 馬 (horse), and 罵 /ma4/ (scold). Children who learn more Chinese characters might be better able to detect this feature of spoken language, because they have a larger corpus of Chinese characters to analyze.

In particular, a specific feature in Chinese semantic-phonetic compound characters may enhance children's Mandarin tone awareness. As described earlier, one Chinese character represents one Chinese syllable, which usually consists of three major phonological elements: an onset, rime, and tone. The phonetic radical in a Chinese semantic-phonetic compound character sometimes provides partial phonological information about the pronunciation of the whole Chinese semantic-phonetic compound character. In one type of the Chinese semantic-phonetic compound characters, the phonetic radical provides phonological information about onset and rime except for tone. For example, 包 /bao1/ (wrap) is the phonetic radical in the Chinese semantic-phonetic compound character, 抱 /bao4/ (hug). In this case, the phonetic radical, 包 /bao1/ (wrap), provides phonological information about onset and rime in pronouncing the entire semantic-phonetic compound character, 抱 /bao4/ (hug). According to my master's thesis equivalency project (Yang, 2007), Taiwanese Mandarin-English bilingual children in the U.S. were able to use the phonological information provided in the phonetic radical when they were trying to pronounce an unfamiliar Chinese semantic-phonetic compound character. Previous research has shown that Mandarin-speaking monolingual children have this ability (Anderson, Li, Ku, & Wu, 2003). Following this line of reasoning, children who learn Chinese characters such as 包/bao1/ (wrap) and 抱 /bao4/ (hug) will thus understand that some Chinese characters may look similar and sound similar but only differ in the tones they carry. The children who learn more Chinese characters may develop an insight like this much faster or better than those who do not. As a result, children who are better Chinese readers may have more advanced Mandarin tone awareness. Nevertheless, given the bidirectional relation between Mandarin tone awareness and

Chinese character reading, an alternative interpretation is that bilingual children who have better Mandarin tone awareness would be better able to use partial information provided in the phonetic radical and thus learn to read more Chinese characters.

Recent research on Mandarin-speaking monolingual children's development of tone awareness or its relation with Chinese reading seems to support my first interpretation, which stresses the importance of literacy experience in promoting children's development of tone awareness. Siok and Fletcher (2001) found that Mandarin-speaking monolingual children's tone awareness correlated with their Chinese character reading ability in Grade 5, but not in Grades 1 through Grade 3. Their result demonstrates that tone awareness is more clearly associated with Chinese character reading in older elementary school children, who have learned to read more Chinese characters than younger elementary-school children. In another study, Ciocca and Lui (2003) examined Cantonese tone awareness in adults and children in three different age groups (4, 6, and 10 years). Their results showed that tone awareness increased with age. By 10 years of age, children's performance on the tone perception task was as accurate as adults'. In light of Ciocca and Lui's results (2003), children of the same age should have similar performance on tone awareness. Although the two bilingual subgroups in the present study were comparable in age, they differed in their Chinese reading ability. Therefore, we might conclude that it is Chinese reading experience that distinguishes their Mandarin tone awareness rather than age. Moreover, a recent study by Shu, Peng, and McBride-Chang (2008) directly provides evidence showing that Mandarin-speaking monolingual children's tone awareness increases with their literacy experience. Their results showed that first graders' tone awareness significantly differed from that of kindergarteners at three different ages. In their study, first graders had started learning Pinyin (a phonetic bridge system used to teach reading in Mainland China), whereas the kindergarteners had not. Therefore, the authors concluded that literacy instruction plays an important role in Mandarin-speaking children's tone awareness. In the present study, both bilingual subgroups received either instruction in Pinyin or Zhu-Yin-Fu-Hao (a phonetic bridge system used to teach reading in Taiwan) when they first entered the Chinese heritage school. Given their equal experience of learning a phonetic bridge system, the Chinese Beginning Reader group still outperformed the Chinese Nonreader group on Mandarin tone awareness. Therefore, it appears that in the present study the Chinese Beginning Reader group's richer knowledge of Chinese characters boosted their Mandarin tone awareness.

Another graded effect of Chinese character reading ability on phonological awareness can be observed in the present study in the pattern of group difference found for English final phoneme awareness. My interpretation is that the Chinese Beginning Reader group differed from the Chinese Nonreader and English Monolingual groups because the Chinese Beginning Reader group was learning to read two writing systems. The Chinese Nonreader and English monolingual groups were similar in that both groups had learned to read only one writing system, but they were different in the sense that the Chinese Nonreader group spoke two languages. The results revealed that the Chinese Nonreader and English Monolingual groups did not differ from each other in English final phoneme awareness, yet the Chinese Beginning Reader group outperformed the two other groups. Taken together, it appears that learning to read two different writing systems enhances bilingual children's English phonemic awareness, specifically, final phoneme awareness. Speaking two languages in itself does not necessarily provide bilingual children with an advantage in English phonemic awareness.

Results from the additional regression analyses were helpful in further examining the unique contribution of Chinese character reading to English phonemic awareness after other demographic and performance variables were controlled. It is noteworthy that although Chinese character reading accounted for approximately 11% of the variance in English phonemic awareness, the effect was no longer statistically significant after the other two demographic variables were taken into account. The two demographic variables, years of receiving Chinese literacy instruction and the amount of Chinese input, together accounted for an even larger proportion of the variance (14%) after Chinese character reading was controlled. These results suggest that Chinese character reading may overlap with number of years of receiving Chinese literacy instruction and the amount of spoken Chinese input. Although Chinese character reading did not account for a unique amount of variance for English final phoneme awareness, it is noteworthy that Chinese character reading overlaps with two other Chinese demographic measures that contribute uniquely to English final phoneme awareness. This cross-linguistic result suggests that the combination of some Chinese literacy and oral language experience may enhance bilingual children's English final phoneme awareness. Previous research (Bialystok, Majumder, & Martin, 2003) concluded that Chinese bilingual children did not have an advantage in *English* phonological awareness, because the phonological structure of Chinese is distant from English. The results of the present study suggest that if bilingual children acquire Chinese literacy and receive spoken Chinese input to a certain extent, they might have an advantage in English phonemic awareness, regardless of the distant relation between Chinese and English phonology. On the other hand, because the relation between the Chinese literacy experience and English final phoneme awareness was only correlational, it is possible that children with stronger phonological awareness may be more likely to succeed in learning to read two languages.

The two bilingual groups in the present study did not differ in Mandarin and English onset-rime awareness. Both groups performed at ceiling on the two tasks, with the average percentages of accuracy ranging from 92.5% to 97.5%. One possible explanation is that the tasks were not difficult enough to differentiate the ability of these two groups of children. Another possible explanation is that bilingual children at this age may have fully developed onset-rime awareness in both languages. As indicated in previous research on English monolingual children's phonological awareness (Anthony et al., 2002), children's phonological awareness develops in a general sequence that is universal across languages. Furthermore, Shu et al. (2008) provided evidence that Mandarin-speaking monolingual children's syllable and rime awareness develops with maturation but not literacy experience.

Taken together, the results of phonological awareness in the present study seem to suggest that bilingual children who read better in Chinese have an advantage in both Mandarin tone awareness and English phonemic awareness. To the best of my knowledge, the present study is the first to demonstrate that Mandarin-English bilingual children's tone awareness increases with their Chinese character reading ability. Also, the present study contributes to the literature on cross-linguistic effects of phonological awareness in bilingual children. Results from previous research focus on the importance of the similarity of the phonological structures in two languages in determining bilingual children's cross-linguistic advantage in phonological awareness (Bialystok et al., 2003). Also, studies on cross-linguistic transfer of phonological awareness have focused on children who speak two languages, without further examining how their literacy expertise in a heritage language would play a role (Durgunoglu et al., 1993; Wang et al., 2005). The present study demonstrates that it is how *well* a bilingual child learns to read a heritage language that is more important in determining whether he or she will have an advantage for phonological awareness in the second language rather than the similarity of the phonological structure of the two languages.

Research Questions 2 and 4: Oral Language Proficiency

Research Questions 2 and 4 hypothesized that only the Chinese Advanced Reader group would have an advantage in oral language proficiency. Specifically, I predicted that the Chinese Beginning Reader and Chinese Nonreader groups would perform similarly on Chinese oral language proficiency measures. Furthermore, I hypothesized that the Chinese Advanced Reader group would outperform the two bilingual subgroups and the English Monolingual group on English oral language proficiency measures. The results were unexpected. In terms of Chinese oral language proficiency, the Chinese Beginning Reader group outperformed the Chinese Nonreader group in Chinese TNW, Chinese NDW, and Chinese MLU. In other comparisons, the English Monolingual group also received higher scores than the Chinese Nonreader group for English TNW and English NDW. The result that there were no group differences between the two bilingual subgroups on English oral language proficiency measures was consistent with my prediction, however.

The two bilingual groups differed in their Chinese character reading ability, which suggests that the group differences found on the Chinese oral language measures could be due to the differing ability of each group to read Chinese characters. Nevertheless, additional results of the hierarchical multiple regression analyses did not indicate that Chinese character reading was the major variable that contributed to the group difference observed in bilingual children's Chinese oral language proficiency. Chinese character reading did not account for statistically significant variance in Chinese oral language proficiency after spoken Chinese output was taken into consideration. When entered first into the hierarchical regression model, Chinese character reading accounted for only 9% of the variance in Chinese oral language proficiency, and it was not statistically significant (p = .056). Instead, parents' estimate amount of the child's spoken

Chinese output accounted for a statistically significant and large proportion of the variance (44%) in measured Chinese oral language proficiency, even after Chinese character reading was controlled. Although Chinese character reading ability contributed to a nearly significant amount of variance in bilingual children's Chinese oral language proficiency, this result suggests that the amount of Chinese output that bilingual children produced in daily life seems to be more important. The bilingual children who produced more Chinese output may have been better able to maintain their Chinese oral language skills than those who tended to speak English most of the time. As a result, it appears that production of a heritage language in daily life is one of the important factors that may differentiate bilingual children's oral language skills in their heritage language in an English-speaking context. On the other hand, given the correlational nature of the relation between Chinese output and Chinese oral language skills, it is also possible that bilingual children with better Chinese oral language skills would be more likely to speak Chinese in their daily life.

Taking the previous results together, it appears that it is Chinese oral language skills that boost children's Chinese reading skills. The children who participated in the present study were in Grades 2 and 3. At this age, oral language proficiency skills may still be important in determining how well they learn to read. Second and third graders seem to be too young to transfer what they learn from reading to their spoken language, to alter it in any substantial way. In addition, the mean score of the Chinese character reading test for the Chinese Beginning Reader group was only 16, which indicates that these children only knew approximately 16 Chinese characters. With this limited number of Chinese characters, they are still considered as *beginning* readers and may still in the phase of learning to decode and recognize Chinese characters. As a result, transferring what they learn from print to spoken language may be less likely to happen in this young age group of children.

My original hypothesis about the importance of Chinese character reading ability in heightening bilingual children's Chinese oral language proficiency did not seem to be supported by the results because the amount of Chinese output that the child produced outweighs the importance of reading ability. Nevertheless, the present study contributes to the literature regarding the use of narrative samples to assess bilingual children's oral language skills. To the best of my knowledge, no study has examined Mandarin-English bilingual children's oral language proficiency using oral narrative language samples. Existing studies often used a standardized vocabulary test such as the Peabody Picture Vocabulary Test (PPVT) or a grammatical judgment test to evaluate bilingual children's oral language proficiency, which only provides information about children's receptive vocabulary or grammatical ability (cf. Bialystok, McBride-Chang, & Luk, 2005; Geva & Zadeh, 2006; Swanson et al., 2008). Previous research has revealed the significance of oral narrative language samples in Spanish and English in predicting Spanish-English bilingual children's reading achievement in both Spanish and English (Miller et al., 2006). Also, a recent study has documented the accuracy and reliability of narrative transcription in Spanish and English (Heilmann, Miller, Iglesias, Fabiano-Smith, Nockerts, & Andriacchi, 2008). The authors stress that it is important to assess children's oral language skills using an unbiased authentic approach. In light of the results obtained from these two studies (Heilmann et al., 2008; Miller et al., 2006), Heilmann and colleagues recommended the use of bilingual children's oral narrative samples in clinical settings as a potential assessment tool to examine bilingual children's skills at multiple linguistic levels. To use oral language narrative samples as an assessment tool, it is important that there must be a well established reference database for children who speak the target language(s). SALT (Miller & Iglesias, 2008) provides bilingual Spanish and English reference databases for story retell which consist of Spanish and English oral narrative retelling samples elicited from over 2,000 Spanish-English bilingual children from Kindergarten through Grade 3 in the U.S. Nevertheless, no such database has been established for Mandarin-English bilingual children. The present study is important in providing preliminary data on typically developing Mandarin-English bilingual children's oral narrative production in Grades 2 and 3.

More importantly, results of the present study suggest that one caveat needs to be considered when oral narrative language samples of a heritage language are used to evaluate bilingual children's oral language proficiency. It is important to obtain information about bilingual children's heritage language output, because it seems to influence children's performance on producing an oral narrative sample in their heritage language. Miller et al. (2006) showed that Spanish and English oral narrative language skills contribute to Spanish-English bilingual children's reading within and across languages. This result seems to imply that bilingual children's heritage oral language proficiency could be a useful tool in identifying their current or later reading difficulties, if any, in a second language. Nevertheless, Miller and colleagues did caution that the value of using narrative sampling may be constrained by the collection of limited data on bilingual children's language and literacy background. By carefully examining children's language and literacy backgrounds, the present study suggests that it is important to take into account bilingual children's heritage language output when the use of their heritage oral narrative samples is considered as an assessment tool. In the U.S., most bilingual children at this age (Grades 2 and 3) have received predominately English instruction at school, for at least 2 to 3 years if not longer because they started attending English-speaking preschools at 3 years. Jia and Aaronson (2003) conducted a longitudinal study on changes in language preferences, language environments, and language proficiency in Mandarin-speaking children and adolescents who immigrated to the U.S. between the ages of 5 and 16 years. Results showed that Mandarin-speaking children who immigrated to the U.S. prior to the age of 9 years quickly switched their language preference to English and became more proficient in English than in Chinese. It is likely that bilingual children who are born in the U.S., such as those who participated in the present study, follow a similar pattern. They may switch their language preference to English at an even earlier age, because of their earlier exposure to English in preschool. Due to this change in linguistic environment, bilingual children may gradually speak less of their heritage language in their daily lives. Consequently, there could be an attrition effect on their heritage language. In other words, their oral language proficiency in their heritage language may decrease.

If this is the case, oral narrative language samples collected in bilingual children's heritage language may not be an appropriate assessment tool for providing information about their English language or reading ability. The present study provides evidence showing that Mandarin-English bilingual children's heritage language output accounted for a significantly large amount of variance in their heritage language proficiency. This information may be useful to teachers or clinicians in determining the usefulness of collecting oral narrative samples in bilingual children's heritage language. Moreover, this information is helpful to future research in explaining bilingual children's language proficiency in their heritage language.

The result that the Chinese Nonreader group performed worse than the English Monolingual group for English TNW and English NDW is consistent with previous findings on bilingual children's vocabulary development. Previous research has shown that bilingual children appear to have a smaller vocabulary size compared to their monolingual peers, both in L1 or L2. It is worth noting, however, that the Chinese Beginning Reader group did not perform significantly worse than their English monolingual peers in English oral language proficiency. Recall that the two bilingual groups were comparable in the demographic variables related to English language and literacy background, and that the Chinese Nonreader group even received more English input and produced more English output in daily life: The two bilingual groups only differed in their Chinese literacy experience. This seems to suggest that acquiring Chinese literacy may help bilingual children to approach the level of English oral language proficiency displayed by their English monolingual peers. The results of the present study did not directly provide evidence showing that it is Chinese character reading experience that allows the Chinese Beginning reader to perform similarly to their English-speaking monolinguals in English oral language proficiency. Nevertheless, it is possible that Chinese Beginning readers' richer Chinese literacy experience may help their English oral language proficiency in the long run.

In sum, results of the present study did not show a strong or significant influence of Chinese character reading on Chinese oral language proficiency, as originally predicted. Nevertheless, the oral narrative samples collected from the present study provide preliminary data on typically developing Mandarin-English bilingual children's oral narrative production in Grades 2 and 3. More importantly, the finding on the relation between the amount of Chinese output and Chinese oral language proficiency extends our knowledge about the use of Chinese oral narrative samples in Mandarin-English bilingual children. Furthermore, in terms of the influence of Chinese character reading on English oral language proficiency, the present study adds new insight to the existing understanding of bilingual children's disadvantage in English oral language proficiency. Specifically, the present study raises the possibility that heritage literacy acquisition may help bridge the gap in English oral language ability between bilingual children and their monolingual peers, if bilingual children accumulate more Chinese literacy experience.

Research Questions 3 and 4: English Reading

Similar to the hypothesis for oral language proficiency, predictions for Research Questions 3 and 4 were that only the Chinese Advanced Reader group would have an advantage in English reading outcomes. I hypothesized that the Chinese Beginning Reader group, the Chinese Nonreader group, and the English monolingual group would perform similarly on English reading subtests. The results partially supported my hypotheses: The two bilingual subgroups performed similarly to their English monolingual peers on the English Word Identification and Passage Comprehension subtests.

Unexpectedly, the MANOVA revealed that the Chinese Beginning Reader group scored higher on the English Word Attack subtest than the Chinese Nonreader and English Monolingual groups. This result suggests that when Mandarin-English bilingual children attain a certain level of Chinese reading ability, they may have an advantage in decoding English nonwords over English monolingual children and their bilingual peers who have only very limited ability to read Chinese. This result is interesting in demonstrating a potential cross-linguistic transfer effect on learning to read two typologically distant languages. As cited earlier, previous research (Wang et al., 2005) has concluded that when children learn to read two different languages such as Chinese and English, they may build on their English and Mandarin phonological awareness which seem to transfer across languages. They would, however, still need to acquire orthographic knowledge of each language independently. The present study supports Wang and colleagues' point with respect to the relation of phonological awareness to reading in both languages, and provides indirect evidence showing that the orthographic knowledge acquired in one language (in this case, Chinese) may enhance the orthographic knowledge in another (in this case, English). Recall that the English Word Attack subtest asked the child to decode English nonwords that conform to English phonotactic patterns. This task tapped into the child's English phonological and orthographic knowledge. A possible explanation of the advantage of Chinese Beginning Readers on this test is that they may have more advanced phonological awareness and orthographic knowledge. This explanation seems to be supported by the preceding findings on Chinese Beginning Readers' better Mandarin tone awareness and English final phoneme awareness. The present study did not evaluate bilingual children's orthographic knowledge, so it is unclear whether they had more advanced English orthographic knowledge than the Chinese Nonreader and English Monolingual groups. Nevertheless, as mentioned previously, learning to map spoken sounds to written words is an important task for early readers. Given that Chinese Beginning Readers had learned to read Chinese better and had been reading Chinese for a longer period of time (approximately one year longer than the Chinese Nonreaders), they might possibly be more experienced in mapping spoken sounds to their corresponding symbols in print. Consequently, they might have developed more advanced orthographic knowledge of the languages that they were learning. As a result, it is reasonable to hypothesize that Chinese Beginning Readers' orthographic knowledge of Chinese would provide them with an advantage in decoding English nonwords.

The preceding, unexpected result also appears to be related to Chinese Beginning readers' amount of Chinese output, nonverbal IQ, and Mandarin phonological awareness, as revealed in the hierarchical multiple regression analysis. Chinese character reading accounted for approximately 20% of variance in the scores on the English Word Attack subtest when it was entered first into the equation. Nevertheless, Chinese character reading did not account for a statistically significant amount of variance in the English Word Attack subtest after these demographic and performance variables were controlled. Chinese output, nonverbal IQ, and Mandarin phonological awareness together accounted for approximately 24% of variance on the English Word Attack subtest, after Chinese character reading was taken into consideration. This result suggests that a number of variables contributed to bilingual children's performance in English nonword reading. Future research would be needed to tease these factors apart. Furthermore, two of the three influential demographic or performance variables were Chinese (i.e., Mandarin) measures, again indicating cross-linguistic influences on English reading.

The Chinese Advanced Reader

Only one child was categorized as a Chinese advanced reader in the present study. She scored 80 out of 200 on the Graded Chinese Character Recognition Test (Huang, 2001). Her score on this test was not only higher than the means in the two bilingual subgroups, but also higher than the average score on the test for third graders (64.55) in Taiwan. The child's extraordinary Chinese reading achievement might be attributed to her high nonverbal IQ and her extensive Chinese literacy environment at home. The child's demographic profile was similar to the other bilingual participants except for her higher nonverbal IQ score. As can be seen in Table 4, her IQ score was almost 2 standard deviations above the mean for the test. It is possible that her high cognitive ability allowed her to achieve an advanced Chinese reading level even while living in the U.S. Nevertheless, nonverbal IQ alone is not sufficient to explain her advanced Chinese reading achievement. Four Chinese Beginning Readers had higher IQ scores than her, but they were not able to read Chinese at a comparable level to the child. Therefore, other factors not directly evaluated in the present study may be related to her Chinese reading ability. One possible factor that I observed at her home was a rich Chinese literacy environment. Her parents reported reading with her in Chinese at home, as did the parents of many other bilingual participants. Based on personal communications with her parents and my observations at her home, reading Chinese storybooks seemed to be a regular activity at home for the child and her brothers. Her mother read and discussed the content of the storybook with them. She also encouraged them to ask if they encountered any unfamiliar Chinese characters or expressions. According to some authors, a Chinese literacy environment at home is critical in determining whether bilingual children are able to achieve biliteracy in an English-speaking country (Li, 2006a). Qualitative data on this family's Chinese literacy practices at home may be helpful in explaining the child's Chinese reading achievement. On the other hand, the rich Chinese literacy environment of the Chinese Advanced Reader may be a result of her high literacy skills, rather than the cause. Her parents may have provided her with a richer literacy environment because she was able to show constant progress in Chinese reading.

When compared with the other three groups, the child scored above the mean for most of the skills assessed in the present study. It is noteworthy that her scores for Chinese TNW, NDW, and MLU were much higher than the means of the two bilingual subgroups. Most important, some Chinese literary expressions that she used in the narrative seemed to reflect her abundant Chinese story reading experience. For example, she used 悶悶不樂 (depressed) to describe the people who lived in the town, as illustrated in the book. This expression was not employed by any other bilingual participants, who only used 不高興 (unhappy) or 生氣 (angry) to describe the people's feelings in the story. The phrase, 悶悶不樂 (depressed), is considered a set phrase or idiomatic expression in Chinese. Chinese set phrases like this are derived from historical events or fables. Children usually learn these through explicit instruction or from story books.

Another example was when she used 父親 and 母親 to refer to *father* and *mother* in her narrative. The words 父親 (*father*) and 母親 (*mother*) have the same meanings as 爸爸 (dad) and 媽媽 (mom). Nevertheless, the first two terms are typically only used in formal oral communication or written expression in modern Chinese society. These two examples demonstrate that the child seemed to use Chinese literary expressions learned from storybook in her oral narrative.

Although data for the Chinese Advanced Reader were all descriptive, they might be still helpful in examining the hypotheses originally proposed for the present study. The following discussions draw upon the child's data and project an overall picture of the present study, under the condition that additional bilingual children who perform similarly to the child are recruited in the future. The Chinese Advanced Reader obtained perfect scores on all of the phonological awareness tasks. Taking her results together with those of the other three groups of children attained for the analyses, Chinese character reading seems to have a graded effect on phonological awareness, as predicted. In terms of Chinese oral language proficiency, she also scored higher than the other two bilingual groups. I originally hypothesized that only the Chinese Advanced Reader group would outperform the other two bilingual groups. Nevertheless, the present study found that the Chinese Beginning Reader group outperformed the Chinese Nonreader group. As a result, if additional Chinese Advanced Readers who perform similarly to the child are recruited, a graded effect of Chinese character reading on Chinese oral language proficiency appears to be a more viable hypothesis than the proposed threshold hypothesis I originally proposed.

In terms of English oral language proficiency, the Chinese Advanced Reader's scores for the English TNW and English NDW measures are between the English Monolingual group and the two bilingual groups. It is worth noting that a Chinese Advanced Reader group may not necessarily outperform their English monolingual peers in all respects. The child, however, obtained the highest score for the English MLU measure. Taken together, a threshold hypothesis, as originally proposed, seems to be supported by the results for the three bilingual groups. For English reading measures, the child scored higher on all measures than the other three groups. Taken together, Chinese character reading seems to have a graded effect on bilingual children's English word attack ability, given that a group difference was found between the Chinese Beginning Reader and Chinese Nonreader groups. Lastly, in terms of English word identification and passage comprehension, the threshold hypothesis would be supported if additional Chinese Advanced Readers also perform similarly to the child. Recall that there were no group differences for these two measures, though the Chinese Advanced Reader outscored all three groups. Interestingly, the Chinese Beginning Reader group in the present study performed much like I hypothesized a Chinese Advanced Reader group would do. This is despite only knowing 16 Chinese characters on average. It seems, then, that only a small amount of Chinese reading may be needed in order to reap some benefit in phonological awareness (Mandarin tones and English final phonemes), Chinese oral language proficiency (TNW, NDW, and MLU), and English reading (word attack). Gains were seen on 6 of 13 measures. The unexpectedly high performance of the Chinese Beginning Reader group portends graded effects for many of the language and reading measures, should an Advanced Chinese Reader group ever be recruited and perform even higher than the Beginning Chinese Reader group.

Practical Implications

Most of the Chinese heritage schools in the U.S. are non-profit institutes initiated and run by the parents of Mandarin-English bilingual children. During weekends or Friday nights while bilingual children are taking classes in the Chinese heritage school, their parents stay at the school for volunteer work. This shows that the parents of Mandarin-English bilingual children are willing to devote their time and energy to maintaining Chinese as a heritage language for their children. Parents do, however, have concerns about whether learning the heritage language may interfere with their child's full acquisition of English (Li, 2006b). The present study found that the Chinese Beginning Reader group did not seem to trade off their English oral language and reading skills when acquiring literacy in their heritage language. The present study lends support for heritage language education in Mandarin-English bilingual children in the U.S. Nevertheless, this implication needs to be made with caution and cannot be generalized to the entire Mandarin-English bilingual population, because the nonverbal IQ and SES of the bilingual participants in the present study were fairly high.

Limitations

Four limitations of this study are worth noting. First, the present study was not able to recruit any more Chinese Advanced Readers in the three Midwestern cities where data collection took place. As a result, some of the proposed hypotheses remain unanswered, especially those examining the threshold hypothesis. I did consider including an older group of bilingual children (i.e., 4^{th} and 5^{th} graders), thinking older students in the heritage schools might have attained higher levels of Chinese character reading. Piloting of 10 4^{th} and 5^{th} graders, however, revealed little increase in the number of Chinese characters that could be read, compared to the Beginning Reader group in the present study (*M* = 17.8 vs. *M* = 16.85; *SD* = 11.03 vs. *SD* = 5.50).

The second limitation concerns the method of administering the phonological awareness tasks. In the present study, phonological awareness tasks were not given to each child in a completely quiet place and the stimuli were not delivered to the child via the same computer throughout the study. Also, the child did not wear headphones when he or she listened to the stimuli. Phonological awareness tasks used in this study required the child's attention to small units of speech. Outside noises may have potentially interfered with the child's perception of the sounds he or she heard and thus may have interfered with his or her performance. Nevertheless, the children's relatively high scores on all of the phonological awareness tasks tend to alleviate this concern.

The third limitation concerns the method of collecting Chinese oral language samples from bilingual children. Two out of 20 Chinese Beginning Readers and nine out of 20 Chinese Nonreaders could not tell a story in Mandarin. Based on the rapport that I established with these bilingual children, I found that not all of them were totally unable to speak Mandarin. Some of them could actually carry on simple daily conversation with me using Mandarin. Generating a narrative demands more advanced language skills, which seem to be insufficient in some bilingual children. Therefore, in order to obtain a more comprehensive assessment of bilingual children's Chinese oral language proficiency, it would be helpful to conduct a conversational interview with each child, in addition to eliciting a narrative.

The fourth limitation was the notable Chinese language and literacy demographic differences that existed between the two bilingual groups. Results from the multiple regression analyses revealed that some of these demographic factors more strongly predicted the skills assessed in the present study than did Chinese character reading ability. The existence of these confounding factors makes it difficult to attribute the bilingual group differences to only Chinese character reading. In the presence of these other variables, it was occasionally difficult to determine the directionality of the relation between Chinese character reading and other performance variables. Nevertheless, in most instances results of multiple regression analyses were helpful in clarifying the direction for the three dimensions. This limitation suggests potential variables that should be well controlled in the design of future bilingual studies. Also, the difficulty of determining the directionality of Chinese character reading and other performance variables leads to an important future direction for research.

Future Directions

The present study adapted a within-bilingual group design attempting to attribute the group difference found in the assessed measures to Chinese character reading. Nevertheless, additional concurrent variables indentified from the analyses indicated that bilingual children comprise a more heterogeneous group. The use of correlational and cross-sectional data or the use of statistical techniques to control for the concurrent variables may not be sufficient in identifying the effects of bilingualism or biliteracy. A longitudinal study that adapts a within-group design would be ideal for the present line of research. For example, I could follow the same group of children at two points in time and measure their Chinese character reading ability and the three domains of language and reading skills. Directionality could be inferred from statistically significant prediction of the three domains at Time 2 from Chinese character reading ability at Time 1, after controlling for initial level Chinese character reading ability at Time 1. Also, an intervention study that measures the three domains after teaching Chinese character reading would be helpful in identifying the effect of Chinese character learning on bilingual children's language and reading skills.

Concerning the first limitation and the potential constraint in generalizing the results of the present study, future research that seeks to recruit Chinese Advanced Readers may consider Western cities in the U.S as a potential research site. The present study did not recruit participants from the Western cities in the U.S., where a larger Taiwanese Mandarin-English bilingual population resides. In addition, future research may be able to recruit participants of a different SES from those who participated in the present study. Other avenues of finding Chinese Advanced Readers to participate seem to be required, e.g., screening families for a rich Chinese literacy environment provided in the home, or recruiting children from regions of the U.S. with larger Taiwanese populations (e.g., California) and longer established Chinese heritage schools, with better financial support and trained professional teachers.

Conclusion

The present study examined the effects of acquiring Chinese literacy on Mandarin-English bilingual children's three domains of language and reading related skills. Overall, the results suggest that learning to read Chinese did not interfere with bilingual children's acquisition of English oral language and reading skills. Instead, bilingual children who attained higher Chinese reading achievement demonstrated better language and reading skills compared to their English monolingual and bilingual peers.

Tables

Table 1

Summary of Spoken Language, Phonetic Bridge System, and Characters in Taiwan, Hong Kong, and Mainland China

	Language	Phonetic Bridge System	Characters (Traditional or Simplified)
Taiwan	Mandarin	Zhu-Yin-Fu-Hao	Traditional
Hong Kong	Cantonese	None	Traditional
Mainland China	Mandarin	Pinyin	Simplified

Table 2

Controlled Factors and Findings in Bilingual Studies

Study	Purpose	Groups	Controlled Confounding Factors	Findings
Bialystok, 1988	To examine the effects of bilingualism on children's metalinguistic development	Study 1: Partial French-English bilinguals Fluent French-English bilinguals English monolinguals Study 2: Partial English-Italian bilinguals Fluent English-Italian bilinguals	Study 1: IQ and SES Study 2: Participants recruited from working-class immigrant areas	Study 1: Both bilingual groups outperformed the English monolingual group on tasks measuring control of linguistic processing. Study 2: Fluent bilinguals outperformed partial bilinguals on tasks measuring analysis of knowledge.
Bialystok, Luk, & Kwan , 2005	To examine bilingual effects on phonological awareness and word-level decoding skills	Spanish-English bilinguals, Hebrew-English bilinguals, Chinese-English bilinguals, English monolinguals	Age	Hebrew-English and Spanish-English bilinguals outperformed English monolinguals on English phonological awareness and word-level decoding tasks; The two groups' phonological decoding skills in L1 were related to those in English; These patterns were not found in Chinese-English bilinguals.
Bialystok, Majumder, & Martin, 2003	To examine whether there is a bilingual advantage in English phonological awareness	Study 1 & 2: French-English bilinguals, English monolinguals Study 3: Spanish-English bilinguals, Chinese-English bilinguals, English monolinguals	All participants recruited from the same middle-class suburb.	Study 1 & 2: The two groups performed similarly on English phonological awareness tasks. Study 3: Spanish-English bilinguals outperformed English monolinguals on the phoneme segmentation task; Chinese-English bilinguals performed worse than the other two groups on the phoneme segmentation task.

Table 2 (Cont.)

Study	Purpose	Groups	Controlled Confounding Factors	Findings
Bialystok, McBride-Chang, & Luk, 2005	To examine Chinese-English bilinguals' phonological awareness and word-level decoding skills	Cantonese-English bilinguals Chinese ESL children English monolinguals	The three groups were similar socially and educationally.	Chinese ESL children outperformed bilinguals on Chinese word decoding; Bilinguals did not perform better than English monolinguals on English phonological awareness and decoding skills.
Bruck & Genesee, 1995	To examine French-English bilingual children's English phonological awareness	French-English bilinguals, English monolinguals	Age, overall verbal ability, IQ, maternal education, and whether parents read to the child at home.	Bilinguals outperformed monolinguals on onset-rime awareness in kindergarten; Bilinguals were better at syllable awareness tasks, whereas monolinguals were better at phoneme awareness in Grade 1.
Campbell & Sais, 1995	To examine Italian-English bilingual children's English metalinguistic awareness	Italian-English bilinguals, English monolinguals	Participants recruited from two schools that possibly matched on SES	Bilinguals outperformed monolinguals on English phonological awareness tasks.
Chen et al., 2004	To examine Cantonese-Mandarin bilingual children's Mandarin phonological awareness	Cantonese-Mandarin bilinguals, Mandarin monolinguals	Maternal and paternal education, IQ	Bilinguals outperformed monolinguals on tone awareness and onset awareness. Both results disappeared by 4th grade.
D'Angiulli, Siegel, & Serra, 2001	To examine cross-linguistic effects between Italian and English phonological skills	Italian-English bilinguals, English-speaking monolinguals, Italian-speaking monolinguals	Age, SES	Significant intercorrelations between English and Italian phonological processing skills.

Table 2 (Cont.)

Study	Purpose	Groups	Controlled Confounding Factors	Findings
Geva & Zadeh, 2006	To compare ESL and monolingual children's reading performance	ESL group with diverse native language backgrounds English monolinguals (EL1)	Age and IQ	EL1 outperformed ESL on English oral language proficiency measures; ESL outperformed EL1 on RAN and English word reading efficiency measures.
Shwartz, Leikin, & Share, 2005	To examine biliteracy effects on the development of phonological awareness and L2 literacy acquisition	biliterate Russian-Hebrew bilinguals monoliterate Russian-Hebrew bilinguals Hebrew monolinguals	IQ, Maternal and Paternal education	The biliterate group outperformed monolingual and monoliterate groups on all phonological awareness tasks.

Note. Studies are presented alphabetically according to the authors' last names.

Table 3

Descriptive Statistics for the "Graded Chinese Character Recognition Test"

Group	*M*	*SD*	Range
Chinese Beginning Reader (*n* = 20)	16.85	5.50	10-31
Chinese Nonreader (*n* = 20)	5.30	1.59	3-8

Note. The maximum score was 200 correctly read Chinese characters.

Table 4

Age, Gender, SES, and Nonverbal Intelligence for Participant Groups

	Age (months)			Gender (n = 20)		SES[a] (Max. = 66)		Nonverbal Intelligence[a]	
Group	*M*	*SD*	Range	Male	Female	*M*	*SD*	*M*	*SD*
CA[b]	101				1	57		130	
CB (n = 20)	104.25	7.43	92-116	8	12	50.35	12.93	119.15	15.90
CN (n = 20)	102.50	7.22	86-113	16	4	54	9.97	109.80	10.76
EM (n = 20)	103.15	7.73	92-116	8	12	54.34	11.25	109.50	15.28
Group Statistical Comparisons	$F(2, 57) = .281$ $p = .756$ OP = .092			$\chi^2(2) = 8.571$ $p = .014$		$F(2, 56) = .739$ $p = .482$ OP = .169		$F(2, 56) = 2.915$ $p = .062$ OP = .547	

Note. Max. = Maximum Score, CA = the Chinese Advanced Reader, CB = Chinese Beginning Reader group, CN = Chinese Nonreader group, EM = English Monolingual group, OP = Observed Power.

[a]The socioeconomic status (SES) index score for one English monolingual child was missing (so n = 19). The Nonverbal Intelligence score for one Chinese Beginning reader was missing (so n = 19).

[b] Information from this child is not included in the statistical analyses.

Table 5

English Language and Literacy Background Information for All Children

	Age of First Exposure to English[a] (A: Before 3; B: 3 to 4; C: 5 to 6)			Years of Receiving Formal English Literacy Instruction[a]		Parents Read with Child at Home in English[a]		English Title Recognition Test: Picture Books (Max. = 20)		English Title Recognition Test: Chapter Books (Max. = 25)	
Group	A	B	C	*M*	*SD*	Yes	No	*M*	*SD*	*M*	*SD*
CA[b]	Before 3			4		Yes		6		6	
CB (*n* = *20*)	16	4	0	4.78	1.68	19	1	8.50	3.25	3.90	3.21
CN (*n* = *20*)	18	1	1	4.33	1.24	16	4	7.10	3.26	3.10	2.00
EM (*n* = *20*)	19	0	0	4.26	1.46	18	1	7.25	3.73	3.15	2.25
Group Statistical Comparisons	$\chi^2(4) = 7.414$ $p = .116$			$F(2, 56) = .714$ $p = .494$ OP = .316		$\chi^2(2) = 3.201$ $p = .202$		$F(4, 112) = .595$ $p = .667$ OP = .191			

Note. Max. = Maximum score, CA = the Chinese Advanced Reader, CB = Chinese Beginning Reader group, CN = Chinese Nonreader group, EM = English Monolingual group, OP = Observed Power.

[a] Information regarding age of first exposure to English, years of receiving formal English literacy instruction, and whether parents read with child at home in English was missing for one English monolingual participant (so *n* = 19).

[b] Information from this child is not included in the statistical analyses.

Table 6

Chinese Language and Literacy Background Information for Each Bilingual Subgroup

	Language Input[c] (%) *M (SD)*	Language Output[c] (%) *M (SD)*	Language Proficiency Rated by Parents[a] *M (SD)*		Years of Receiving Formal Chinese Literacy Instruction *M (SD)*	Parents Read with Child at Home in Chinese	
Group	Chinese	Chinese	English	Chinese	Years	Yes	No
CA[b]	35	35	4	3	4	Yes	
CB (n = 20)	51 (17)	39 (26)	3.83 (.38)	2.50 (.61)	3.62 (1.36)	16	4
CN (n = 20)	39 (18)	18 (23)	3.77 (.54)	2.33 (.84)	2.50 (1.24)	10	10
Group Statistical Comparisons	$F(1, 38) = 5.134$ $p = .029$	$F(1, 38) = 8.194$ $p = .007$	$F(2, 33) = .287$ $p = .753$		$F(1, 38) = 7.406$ $p = .01$	$\chi^2(1) = 3.956$ $p = .047$	

Note. CA = the Chinese Advanced Reader, CB = Chinese Beginning Reader group, CN = Chinese Nonreader group, and Language Proficiency Rated by Parents: Score of 4 = Native-like proficiency with few grammatical errors, good vocabulary, understands most of what is said; Score of 3 = Good proficiency with some grammatical errors, some social and academic vocabulary, understands most of what is said; and Score of 2 = Limited proficiency with grammatical errors, limited vocabulary, understands the general idea of what is being said.

[a] Information for parents' rating of the child's language proficiency in English and Chinese was missing for two children in each group (so n = 18).

[b] Information from this child is not included in the statistical analyses.

[c] Any percentage of input that was not Chinese was English. For example, The CB group had 51% of its input in Chinese and thus 49% of its input was in English.

Table 7

Summary of Assessment Measures

	Chinese	English
Phonological Awareness Tasks	1. Onset-Rime Matching Task 2. Tone Matching Task	1. Onset-Rime Matching Task 2. Final Phoneme Matching Task
Reading Tests	1. Graded Character Recognition Test (Huang, 2001) 2. Chinese Reading Comprehension Test	1. Word Identification Subtest 2. Word Attack Subtest 3. Passage Comprehension Subtest (All Subtests are from the Woodcock Reading Mastery Tests-Revised, 1987)
Oral Language Proficiency	Oral Narrative Language Sample from the Wordless Picture Book, *The Flower Man* (Ludy, 2005)	Oral Narrative Language Sample from the Wordless Picture Book, *The Flower Man* (Ludy, 2005)
Exposure to Print Measure	English Title Recognition Test (adapted from Cunningham & Stanovich, 1991)	
Nonverbal Intelligence	Test of Nonverbal Intelligence, Third Edition (TONI-3, Brown, Sherbenou, & Johnson, 1997)	
Language Use	Language Background Survey (adapted from Gutierrez-Clellen, & Kreiter, 2003; Kovelman, Baker, Petitto, 2008)	

Table 8

Tasks Administered to Bilingual Subgroups and Monolingual English-Speaking Group

	Bi-Advanced	Bi-Beginning	Bi-Nonreader	ME
Chinese Phonological Awareness Tasks: Onset-Rime and Tone Matching Tasks	√	√	√	
English Phonological Awareness Tasks: Onset-Rime and Final Phoneme Matching Tasks	√	√	√	√
Graded Chinese Character Recognition Test	√	√	√	
Chinese Reading Comprehension Test	√			
English Woodcock Reading Mastery Word Identification, Word Attack, and Passage Comprehension Subtests	√	√	√	√
Chinese Oral Language Proficiency Task	√	√	√	
English Oral Language Proficiency Task	√	√	√	√
English Title Recognition Test	√	√	√	√
Test of Nonverbal Intelligence Test (TONI-3)	√	√	√	√
Language Background Survey (for Parents)	√	√	√	√ *

Note. Bi-Advanced = The Chinese Advanced Reader group, Bi-Beginning = The Chinese Beginning Reader group, Bi-Nonreader = The Chinese Nonreader Group, ME = Monolingual English-Speaking Children group (Control Group), √ = Test or Task Administered to the Group √* = Parents filled out the first page of the survey.

Table 9

Descriptive Statistics and MANOVA Results for the Mandarin Phonological Awareness Tasks by Group

	Mandarin Onset-Rime Awareness Task (Max. = 20)			Mandarin Tone Awareness Task (Max. = 20)		
Group	*M*	*SD*	Range	*M*	*SD*	Range
CA[b]			20			20
CB[a]	18.5	2.35	12-20	18.05	2.74	11-20
CN[a]	18.5	1.27	16-20	14.70	3.09	8-20
	MANOVA Results					
F	$F(1, 38) = .465$			$F(1, 38) = 14.105$		
p	$p = .499$			$p < .001$		
η_p^2				.271		
OP	.10			.955		

Note. Max. = Maximum raw score. CA = Chinese Advanced Reader, CB = Chinese Beginning Reader group, CN = Chinese Nonreader group, η_p^2 = Partial Eta Squared, OP = Observed Power.
[a] $n = 20$.
[b] Data obtained from this child is only presented descriptively and is not included in the statistical analyses.

Table 10

Descriptive Statistics and MANOVA Results for the Mandarin Narrative Measures by Group

Measure		CA[b]	CB[a]	CN[a]	*F*	*p*	η_p^2	OP
Chinese Number of Utterances	*M*	25	30.40	15.30	*F*(1, 38) = 8.149	.007*	.177	.794
	SD		15.87	17.53				
	Range		0-59	0-51				
Chinese TNW	*M*	285	208.35	103.00	*F*(1, 38) = 7.603	.009*	.167	.766
	SD		116.38	125.09				
	Range		0-461	0-387				
Chinese NDW	*M*	86	66.65	35.45	*F*(1, 38) = 8.301	.006*	.179	.802
	SD		28.84	38.90				
	Range		0-107	0-107				
Chinese MLU	*M*	11.40	6.29	3.64	*F*(1, 38) = 7.189	.011*	. 159	.743
	SD		2.63	3.53				
	Range		0-10.52	0-9.03				

Note. CA = the Chinese Advanced Reader, CB = Chinese Beginning Reader group, CN = Chinese Nonreader group, TNW = Total Number of Words, NDW = Number of Different Words, MLU = Mean Length of Utterance, η_p^2 = Partial Eta Squared, OP = Observed Power.
[a] *n* = 20.
[b] Data obtained from this child is only presented descriptively and is not included in the statistical analyses.
**p* < .05.

Table 11

Descriptive Statistics and MANOVA Results for the English Phonological Awareness Tasks by Group

	English Onset-Rime Awareness Task (Max. = 20)			English Final Phoneme Awareness Task (Max. = 20)		
Group	*M*	*SD*	Range	*M*	*SD*	Range
CA[b]	20			20		
CB[a]	19.50	.94	16-20	19.20	1.67	14-20
CN[a]	19.05	1.46	16-20	18.30	1.52	14-20
EM[a]	18.85	1.66	13-20	17.45	1.84	13-20
	MANOVA Results					
F	$F(2, 54) = 1.411$			$F(2, 54) = 9.922$		
p	$p = .253$			$p < .001$		
η_p^2				.269		
OP	.29			.979		
Post Hoc Tests				CB > CN, $p = .021$ CB > EM, $p < .001$		

Note. Max. = Maximum raw score, CA = the Chinese Advanced Reader CB = Chinese Beginning Reader group, CN = Chinese Nonreader group, EM = English Monolingual group, η_p^2 = Partial Eta Squared, OP = Observed Power.

[a] $n = 20$.

[b] Data obtained from this child is only presented descriptively and is not included in the statistical analyses.

Table 12

Descriptive Statistics and MANOVA Results for the English Narrative Measures by Group

Measure		CA[c]	CB[a]	CN[a]	EM[b]	*F*	*p*	η_p^2	OP	Post Hoc Tests
English Number of Utterances	*M*	28	36.47	32.68	49.95	$F(2, 54) = 2.412$	.099	.081	.466	
	SD		14.36	17.57	38.10					
	Range		17-71	12-81	15-183					
English TNW	*M*	318	226.78	211.26	345.60	$F(2, 54) = 5.331$	.008*	.165	.819	EM > CN,
	SD		87.50	100.14	191.88					$p = .041$
	Range		108-418	76-458	145-868					
English NDW	*M*	109	97.42	92.31	126.00	$F(2, 54) = 4.013$	.024*	.129	.693	EM > CN,
	SD		35.22	31.37	46.17					$p = .038$
	Range		53-180	44-168	70-237					
English MLU	*M*	11.29	7.88	8.12	9.00	$F(2, 54) = 2.558$	.087	.087	.490	
	SD		1.91	1.45	1.52					
	Range		5.18-12.04	4.91-10.54	5.79-10.97					

Note. CA = the Chinese Advanced Reader, CB = Chinese Beginning Reader group, CN = Chinese Nonreader group, EM = English Monolingual group, TNW = Total Number of Words, NDW = Number of Different Words, MLU = Mean Length of Utterance, η_p^2 = Partial Eta Squared, OP = Observed Power.

[a] Data on English TNW, NDW, and MLU was missing for one child ($n = 19$).

[b] $n = 20$

[c] Data obtained from this child is only presented descriptively and is not included in the statistical analyses.

*$p < .05$.

Table 13

Descriptive Statistics and MANOVA Results for the English Reading Subtests of the Woodcock Reading Mastery Test-Revised (WRMT-R) by Group

	English Word Identification (Max. = 106)			English Word Attack (Max. = 45)			English Passage Comprehension (Max. = 68)		
	M	*SD*	Range	*M*	*SD*	Range	*M*	*SD*	Range
CA[c]	91			43			43		
CB[a]	81.10	12.38	57-100	40	2.41	36-44	40.15	7.44	30-60
CN[b]	75.95	13.71	57-103	36.21	5.02	25-45	35.53	5.21	27-44
EM[a]	77.20	14.31	53-96	33.75	6.31	22-44	37.75	5.85	28-52
				MANOVA Results					
F	$F(2, 54) = 1.117$			$F(2, 54) = 8.609$			$F(2, 54) = 2.713$		
P	$p = .335$			$p < .001$			$p = .075$		
η_p^2	.040			.242			.091		
OP	.236			.960			.515		
Post Hoc Tests				CB > CN, p =.024 CB > EM, p <.001					

Note. Max. = Maximum raw score, CA = the Chinese Advanced Reader, CB = Chinese Beginning Reader group, CN = Chinese Nonreader group, EM = English Monolingual group, OP = Observed Power.

[a] $n = 20$.

[b] Data on the English Word Identification, Word Attack, and Passage Comprehension was missing for one child in the CN group (so $n = 19$).

[c] Data obtained from this child is only presented descriptively and is not included in the statistical analyses.

Table 14

Hierarchical Regression Analyses Predicting Mandarin Tone Awareness Using IQ and Chinese Character Reading Ability

Independent Variables	R^2	Adjusted R^2	ΔR^2	ΔF	p
Block 1: IQ	.167	.145	.167	7.418	.01*
Block 2: CCR	.329	.291	.162	8.673	.006*
Block 1: CCR	.265	.245	.265	13.332	<.001*
Block 2: IQ	.329	.291	.064	3.424	.072

Note. CCR = Chinese character reading.
*$p < .05$.

Table 15

Hierarchical Regression Analyses Predicting Chinese Character Reading Ability Using Mandarin Tone Awareness and Years of Receiving Chinese Literacy Instruction

Independent Variables	R^2	Adjusted R^2	ΔR^2	ΔF	p
Block 1: YCL	.150	.127	.150	6.507	.015*
Block 2: MTA	.347	.311	.197	10.886	.002*
Block 1: MTA	.265	.246	.265	13.692	.001*
Block 2: YCL	.347	.312	.082	4.654	.038*

Note. CCR = Chinese character reading, MTA = Mandarin Tone Awareness, YCL = Years of Receiving Formal Chinese Literacy Instruction.
*$p < .05$.

Table 16

Hierarchical Regression Analyses Predicting English Final Phoneme Awareness Using Years of Receiving Chinese Literacy Instruction, Chinese Input, and Chinese Character Reading Ability.

Independent Variables	R^2	Adjusted R^2	ΔR^2	ΔF	p
Block 1: Cinput and YCL	.233	.192	.233	5.626	.007*
Block 2: CCR	.250	.188	.017	.820	.371
Block 1: CCR	.110	.086	.110	4.688	.037*
Block 2: Cinput and YCL	.250	.188	.140	3.371	.045*

Note. CCR = Chinese character reading, Cinput = Chinese input, YCL = Years of Receiving Formal Chinese Literacy Instruction.
*$p < .05$.

Table 17

Hierarchical Regression Analyses Predicting Chinese Oral Language Proficiency Using Chinese Output and Chinese Character Reading Ability.

Independent Variables	R^2	Adjusted R^2	ΔR^2	ΔF	p
Block 1: Coutput	.521	.509	.521	41.383	<.001*
Block 2: CCR	.531	.506	.010	.761	.388
Block 1: CCR	.093	.069	.093	3.880	.056
Block 2: Coutput	.531	.506	.438	34.577	<.001*

Note. CCR = Chinese character reading, Coutput = Chinese output.
*$p < .05$.

Table 18

Hierarchical Regression Analyses Predicting English Word Attack Ability Using Chinese Output, Mandarin Phonological Awareness, IQ, and Chinese Character Reading Ability.

Independent Variables	R^2	Adjusted R^2	ΔR^2	ΔF	p
Block 1: Coutput, MPA, and IQ	.421	.370	.421	8.230	<.001*
Block 2: CCR	.431	.362	.010	.595	.446
Block 1: CCR	.196	.173	.196	8.752	.005*
Block 2: Coutput, MPA, and IQ	.431	.362	.235	4.550	.009*

Note. CCR = Chinese character reading, Coutput = Chinese output, MPA = Mandarin Phonological Awareness.
*p < .05.

Figures

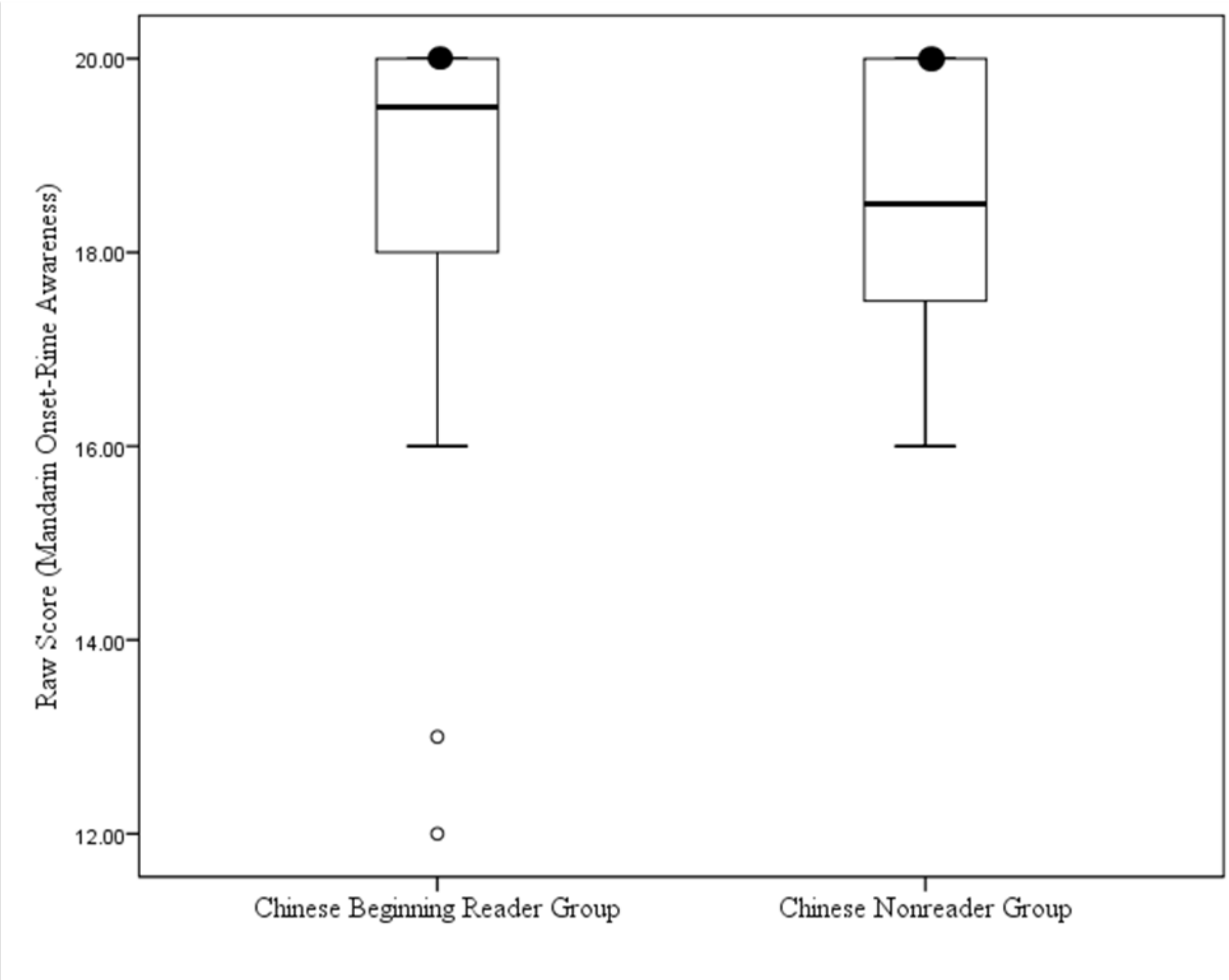

Figure 1. Box plot of the two bilingual subgroups' performance on the Mandarin Onset-Rime Awareness task. The box represents the middle 50% of the data sample. The space between the box and the lower whisker represents the bottom 25% of the data sample, and the space between the box and the upper whisker represents the remaining 25% of the data sample. The solid black line within each box represents the median score in each group. The solid black dot indicates the Chinese Advanced Reader's score (20). The two open circles represent the two outliers in the Chinese Beginning Reader group. An outlier is a score that falls more than 1.5 box-lengths from the edge of the box.

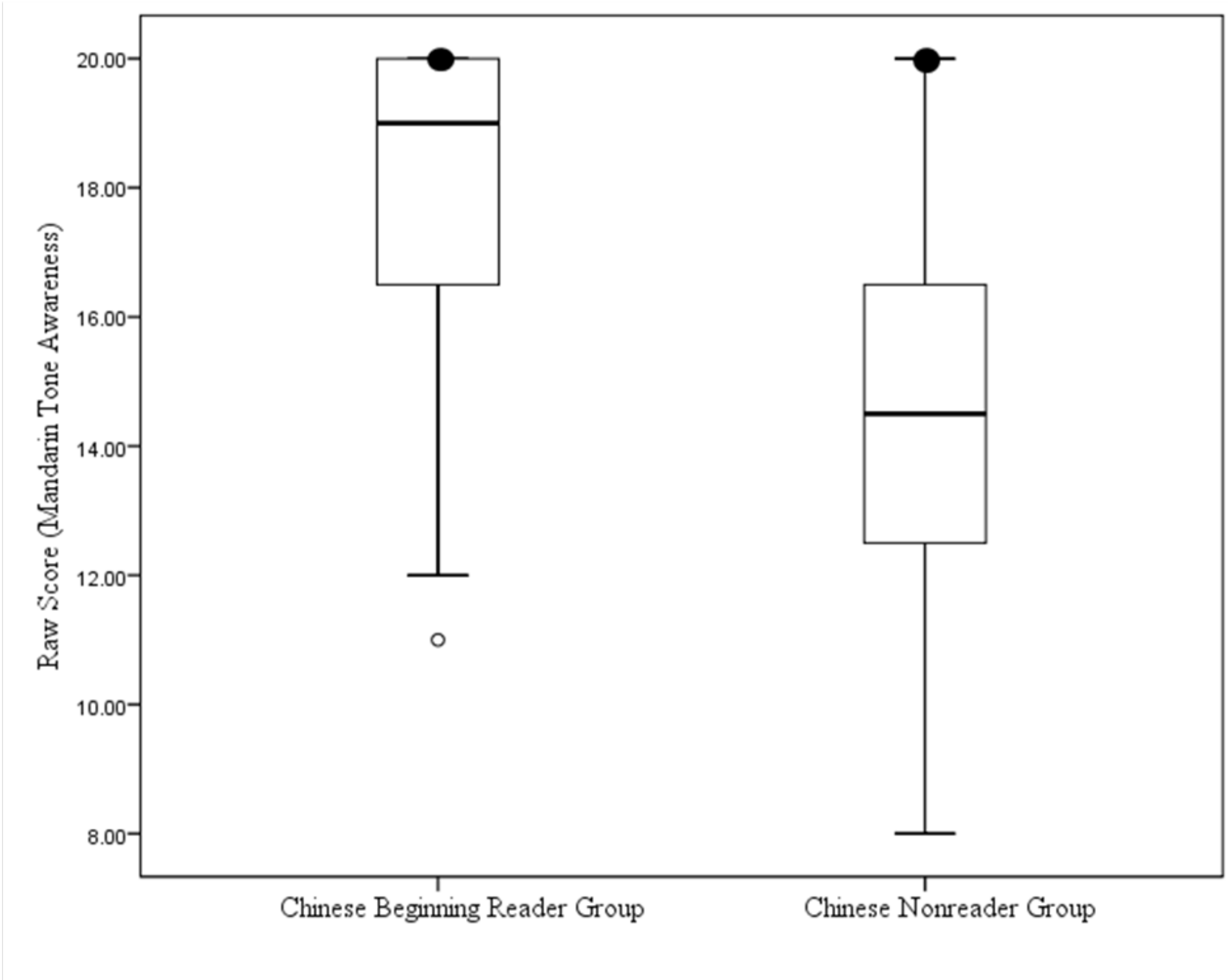

Figure 2. Box plot of the two bilingual subgroups' performance on the Mandarin Tone Awareness task. The box represents the middle 50% of the data sample. The space between the box and the lower whisker represents the bottom 25% of the data sample, and the space between the box and the upper whisker represents the remaining 25% of the data sample. The solid black line within each box represents the median score in each group. The solid black dot indicates the Chinese Advanced Reader's score (20). The open circle represents an outlier in the Chinese Beginning Reader group. An outlier is a score that falls more than 1.5 box-lengths from the edge of the box.

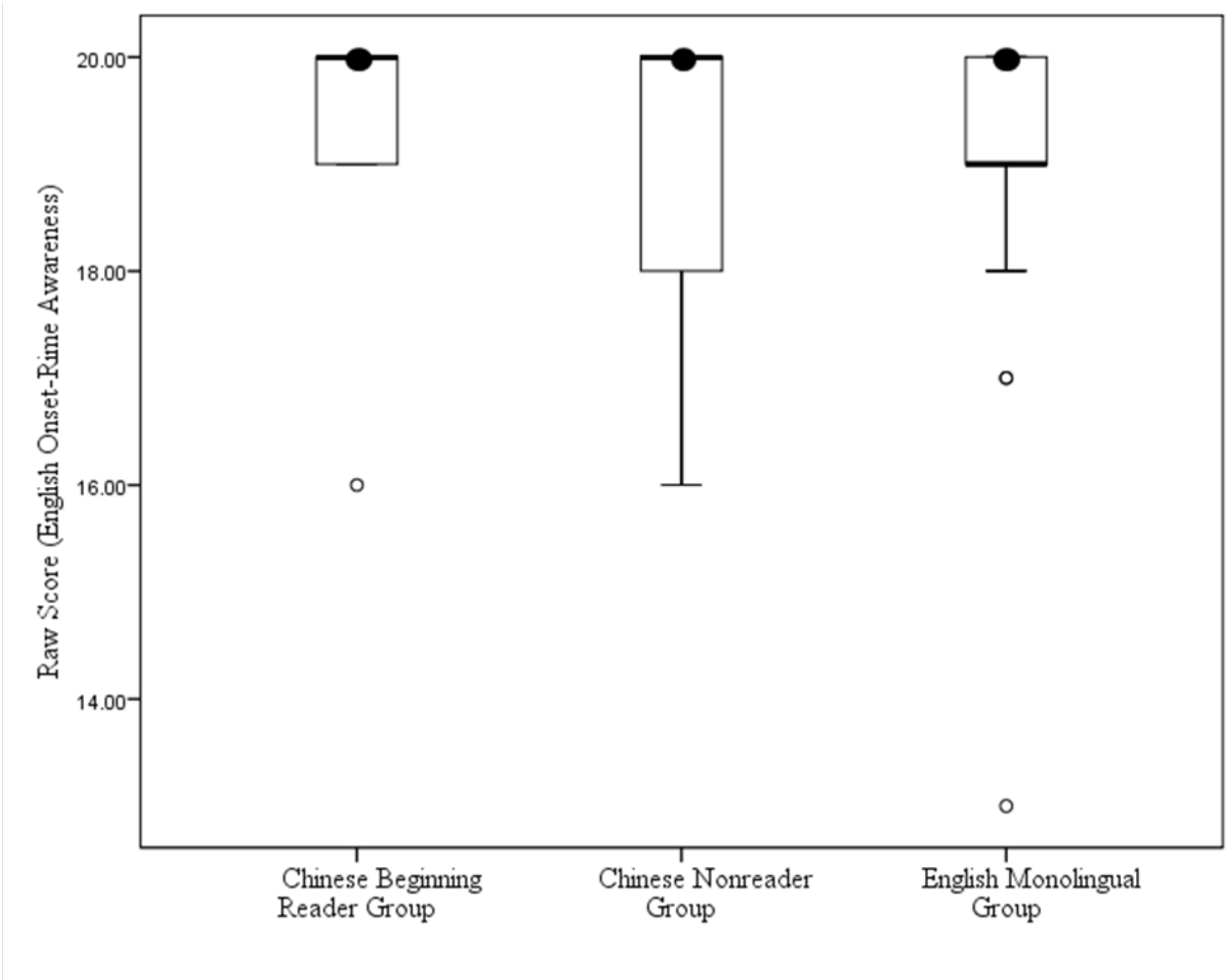

Figure 3. Box plot of the three groups' performance on the English Onset-Rime Awareness task. The box represents the middle 50% of the data sample. The space between the box and the lower whisker represents the bottom 25% of the data sample, and the space between the box and the upper whisker represents the remaining 25% of the data sample. The solid black line within each box represents the median score in each group. The solid black dot indicates the Chinese Advanced Reader's score (20). An open circle represents an outlier. An outlier is a score that falls more than 1.5 box-lengths from the edge of the box.

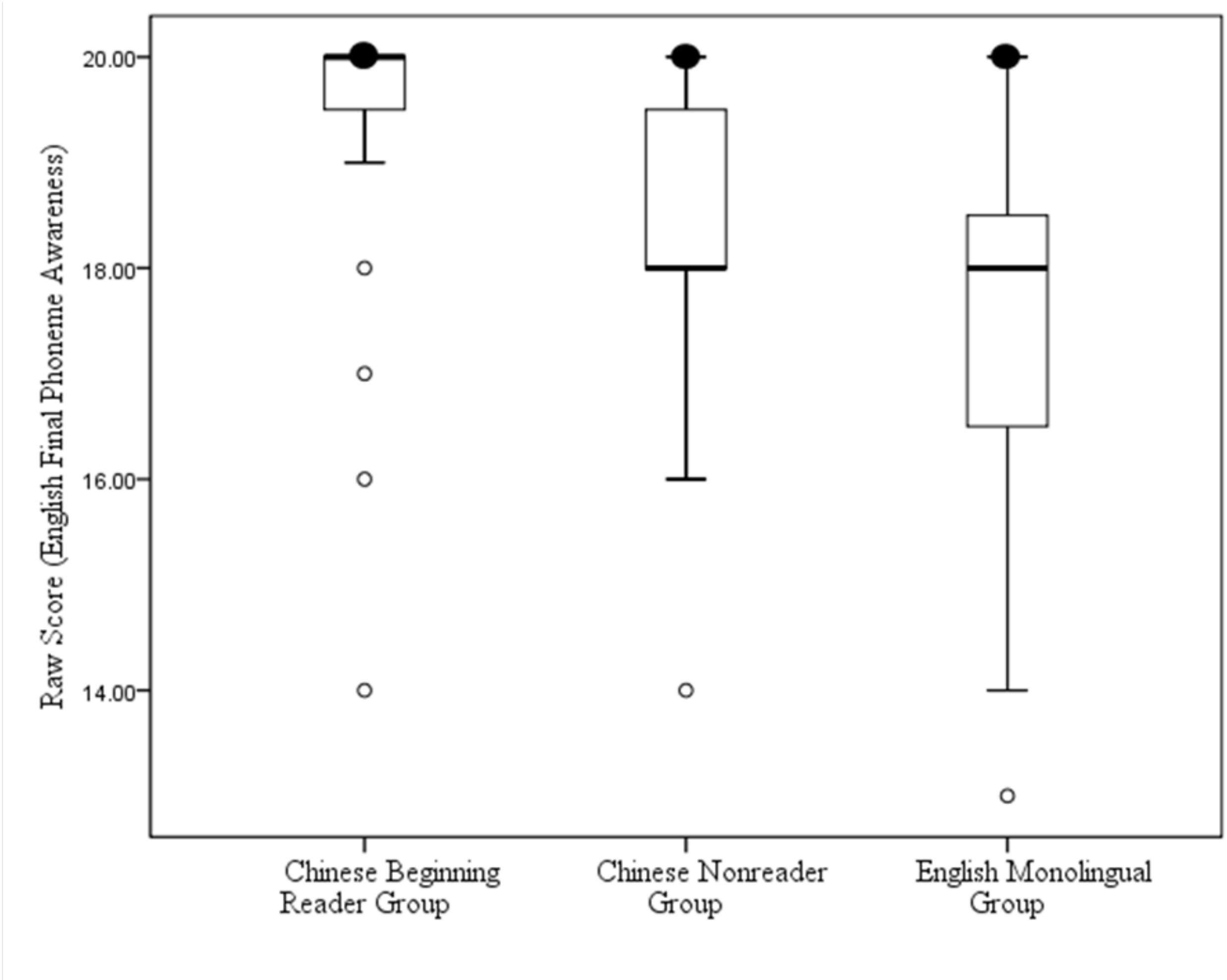

Figure 4. Box plot of the three groups' performance on the English Final Phoneme Awareness task. The box represents the middle 50% of the data sample. The space between the box and the lower whisker represents the bottom 25% of the data sample, and the space between the box and the upper whisker represents the remaining 25% of the data sample. The solid black line within each box represents the median score in each group. The solid black dot indicates the Chinese Advanced Reader's score (20). An open circle represents an outlier. An outlier is a score that falls more than 1.5 box-lengths from the edge of the box.

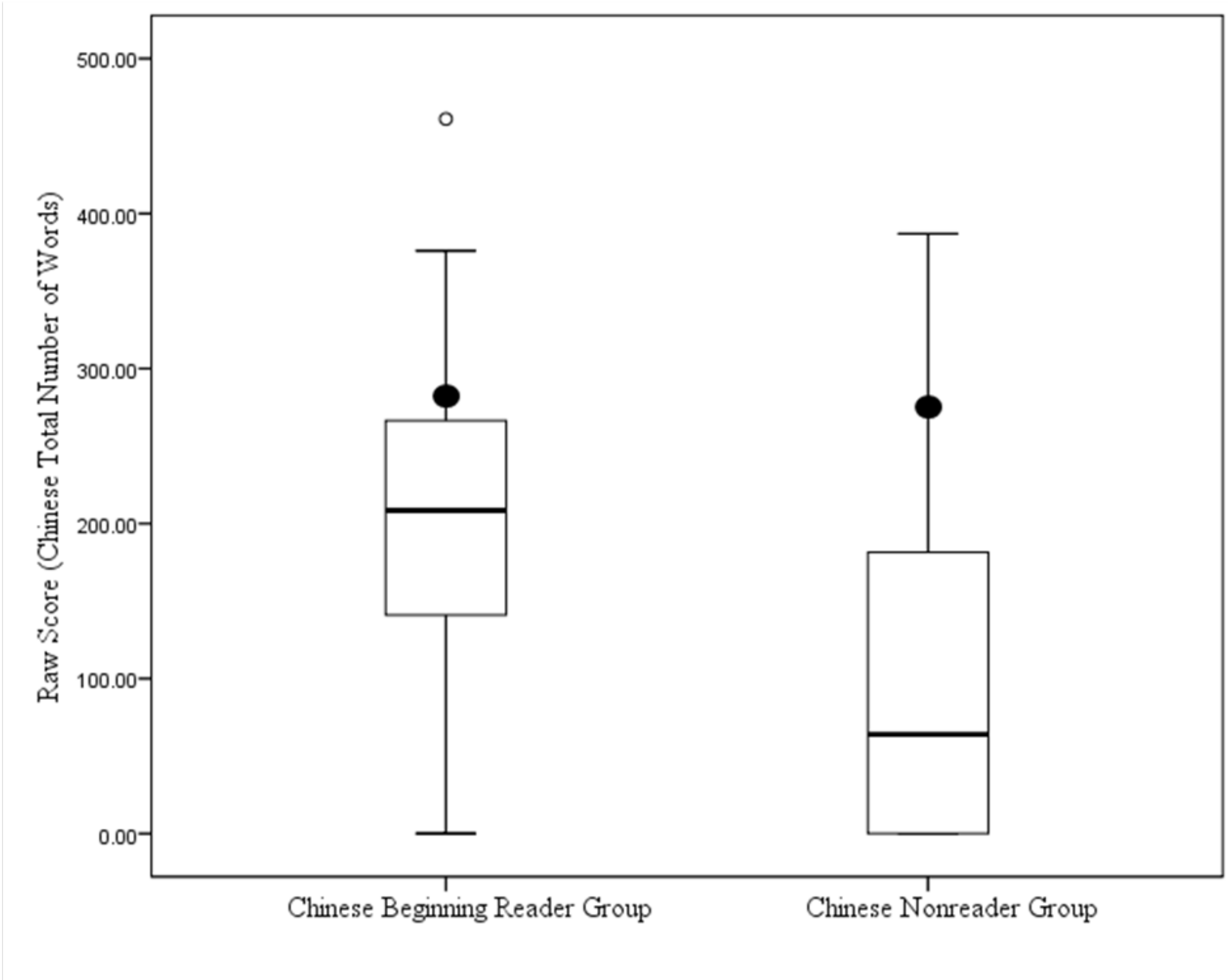

Figure 5. Box plot of the two bilingual subgroups' performance on the Chinese Total Number of Words (TNW). The box represents the middle 50% of the data sample. The space between the box and the lower whisker represents the bottom 25% of the data sample, and the space between the box and the upper whisker represents the remaining 25% of the data sample. The solid black line within each box represents the median score in each group. The solid black dot indicates the Chinese Advanced Reader's score (285). An open circle represents an outlier. An outlier is the score that falls more than 1.5 box-lengths from the edge of the box.

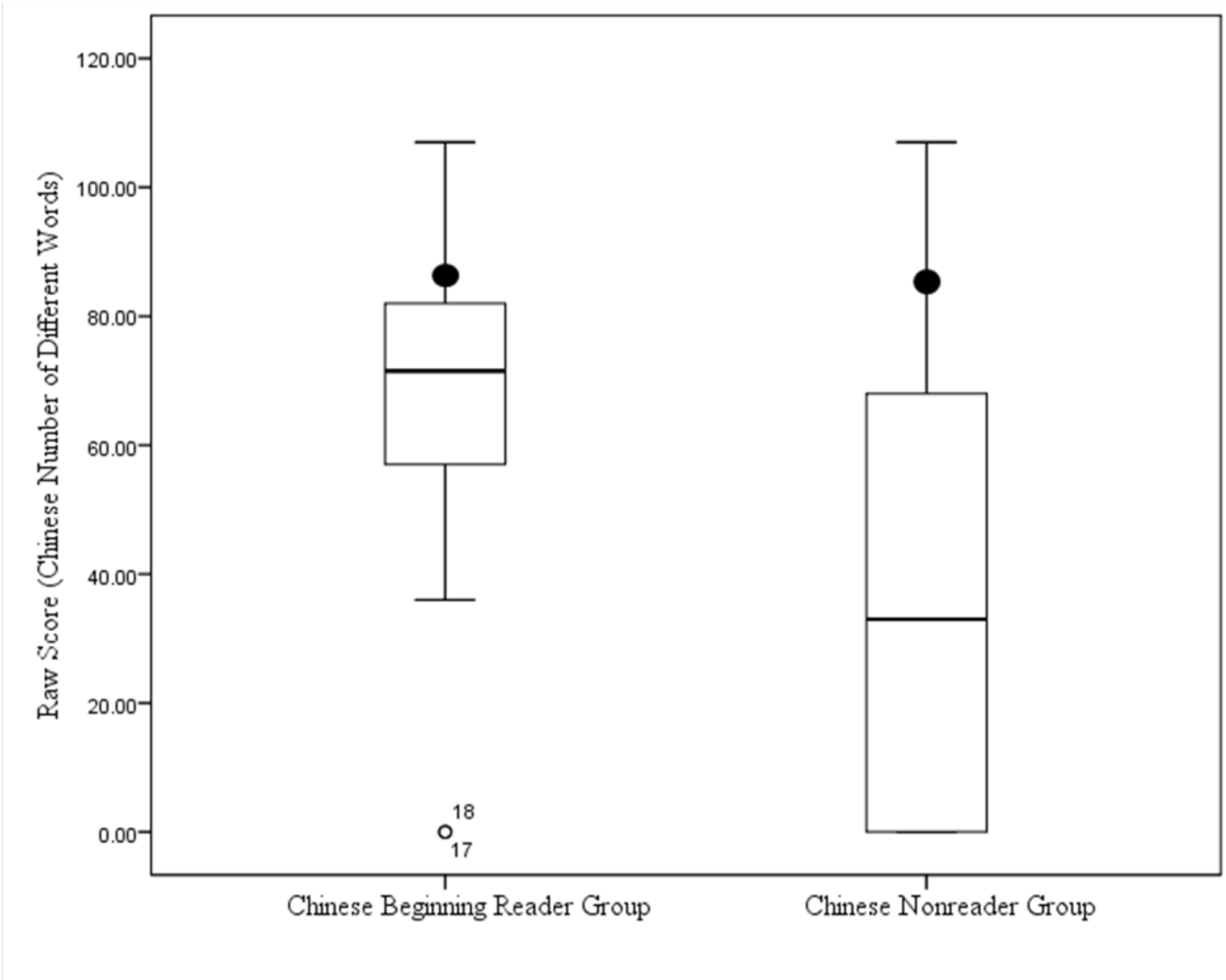

Figure 6. Box plot of the two bilingual subgroups' performance on the Chinese Number of Different Words (NDW). The box represents the middle 50% of the data sample. The space between the box and the lower whisker represents the bottom 25% of the data sample, and the space between the box and the upper whisker represents the remaining 25% of the data sample. The solid black line within each box represents the median score in each group. The solid black dot indicates the Chinese Advanced Reader's score (86). The open circle represents *two* outliers (Child 17 and 18). An outlier is the score that falls more than 1.5 box-lengths from the edge of the box.

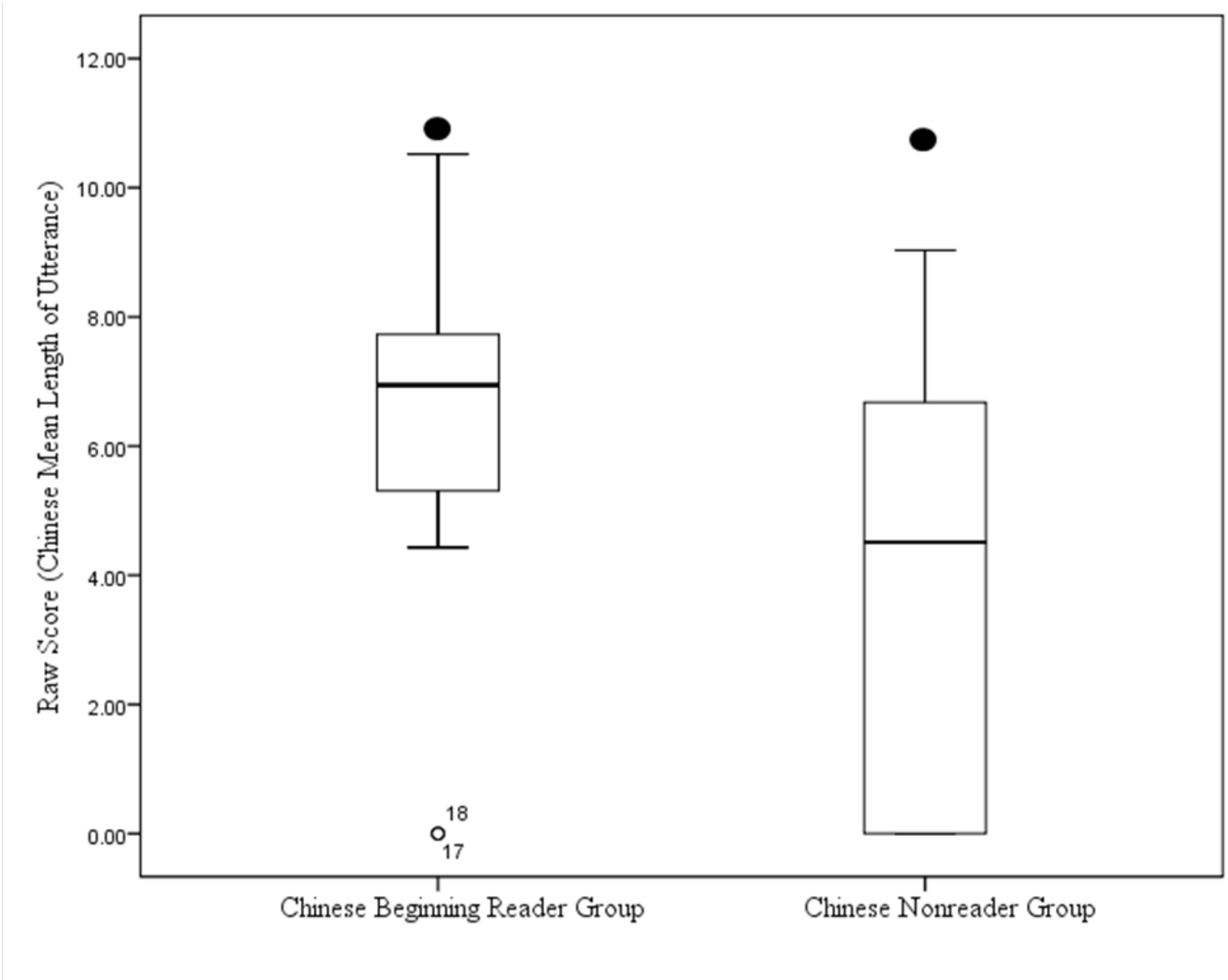

Figure 7. Box plot of the two bilingual subgroups' performance on the Chinese Mean Length of Utterance (MLU). The box represents the middle 50% of the data sample. The space between the box and the lower whisker represents the bottom 25% of the data sample, and the space between the box and the upper whisker represents the remaining 25% of the data sample. The solid black line within each box represents the median score in each group. The solid black dot indicates the Chinese Advanced Reader's score (11.40). The open circle represents *two* outliers (Child 17 and 18). An outlier is a score that falls more than 1.5 box-lengths from the edge of the box.

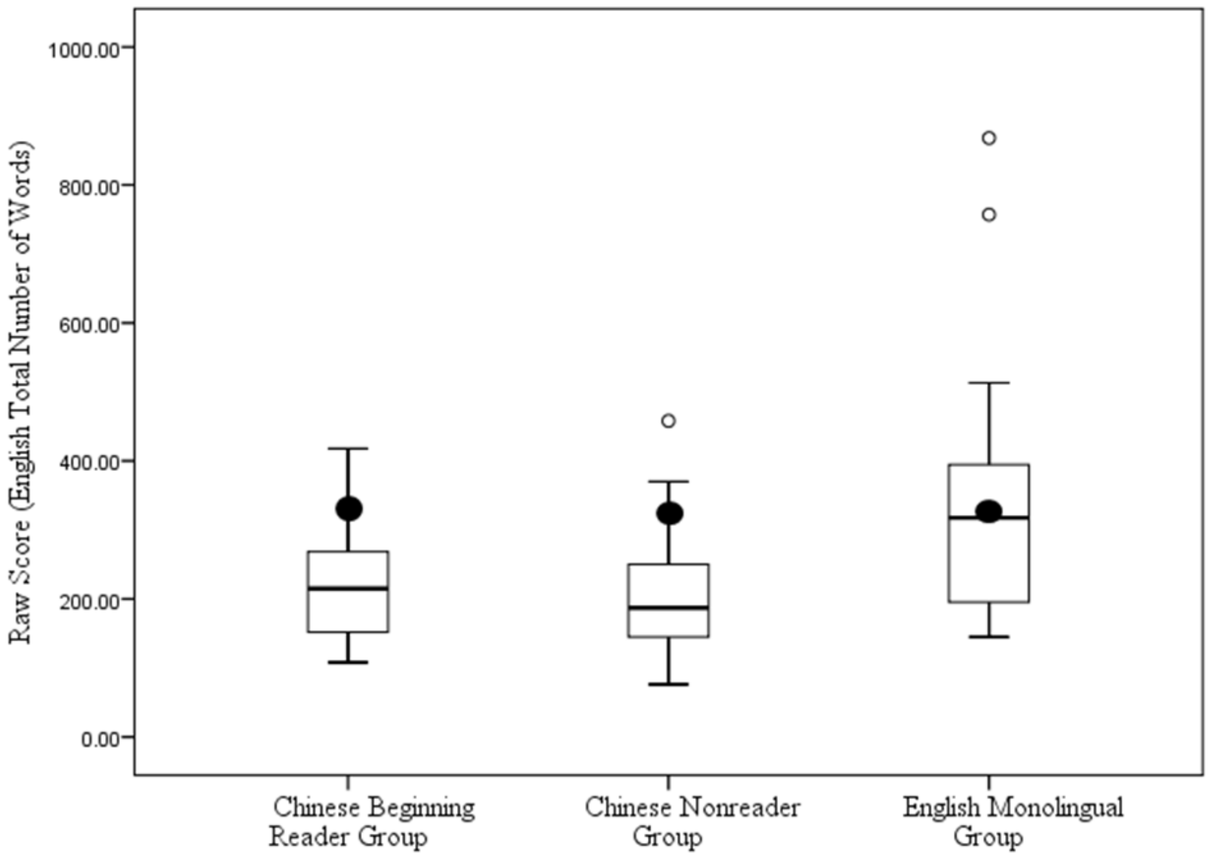

Figure 8. Box plot of the three groups' performance on the English Total Number of Words (TNW). The box represents the middle 50% of the data sample. The space between the box and the lower whisker represents the bottom 25% of the data sample, and the space between the box and the upper whisker represents the remaining 25% of the data sample. The solid black line within each box represents the median score in each group. The solid black dot indicates the Chinese Advanced Reader's score (318). An open circle represents an outlier. An outlier is a score that falls more than 1.5 box-lengths from the edge of the box.

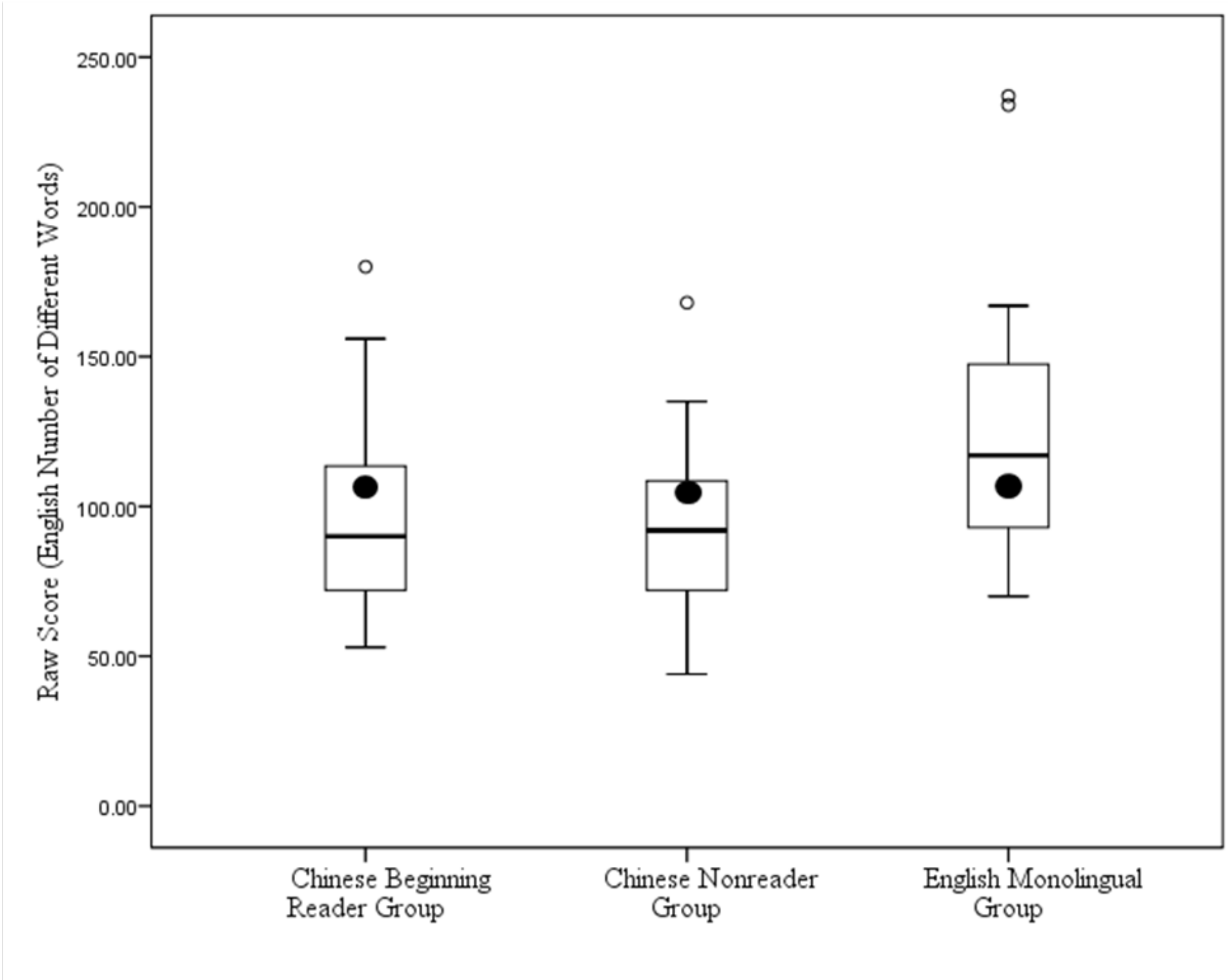

Figure 9. Box plot of the three groups' performance on the English Number of Different Words (NDW). The box represents the middle 50% of the data sample. The space between the box and the lower whisker represents the bottom 25% of the data sample, and the space between the box and the upper whisker represents the remaining 25% of the data sample. The solid black line within each box represents the median score in each group. The solid black dot indicates the Chinese Advanced Reader's score (109). An open circle represents an outlier. An outlier is a score that falls more than 1.5 box-lengths from the edge of the box.

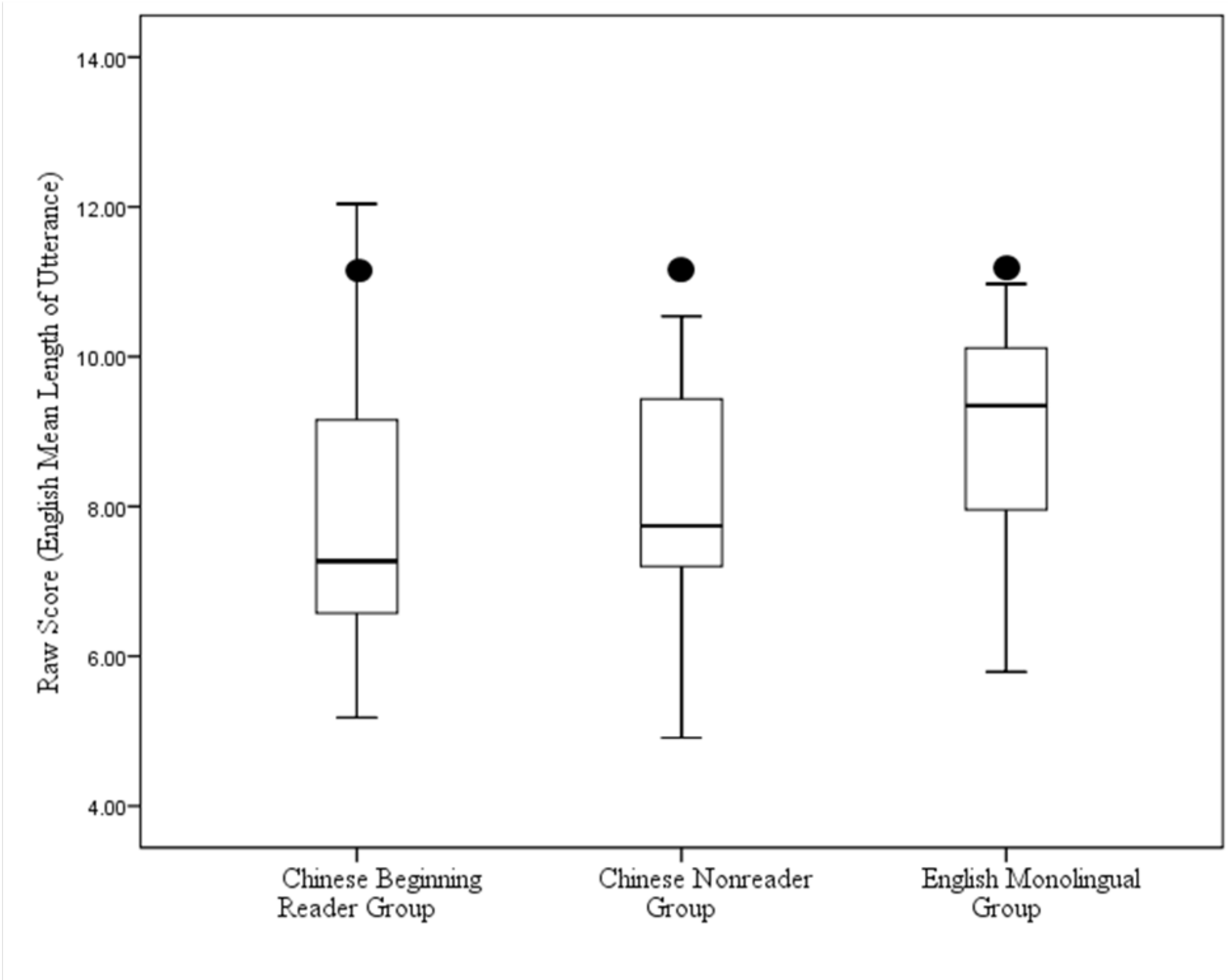

Figure 10. Box plot of the three groups' performance on the English Mean Length of Utterance (MLU). The box represents the middle 50% of the data sample. The space between the box and the lower whisker represents the bottom 25% of the data sample, and the space between the box and the upper whisker represents the remaining 25% of the data sample. The solid black line within each box represents the median score in each group. The solid black dot indicates the Chinese Advanced Reader's score (11.29).

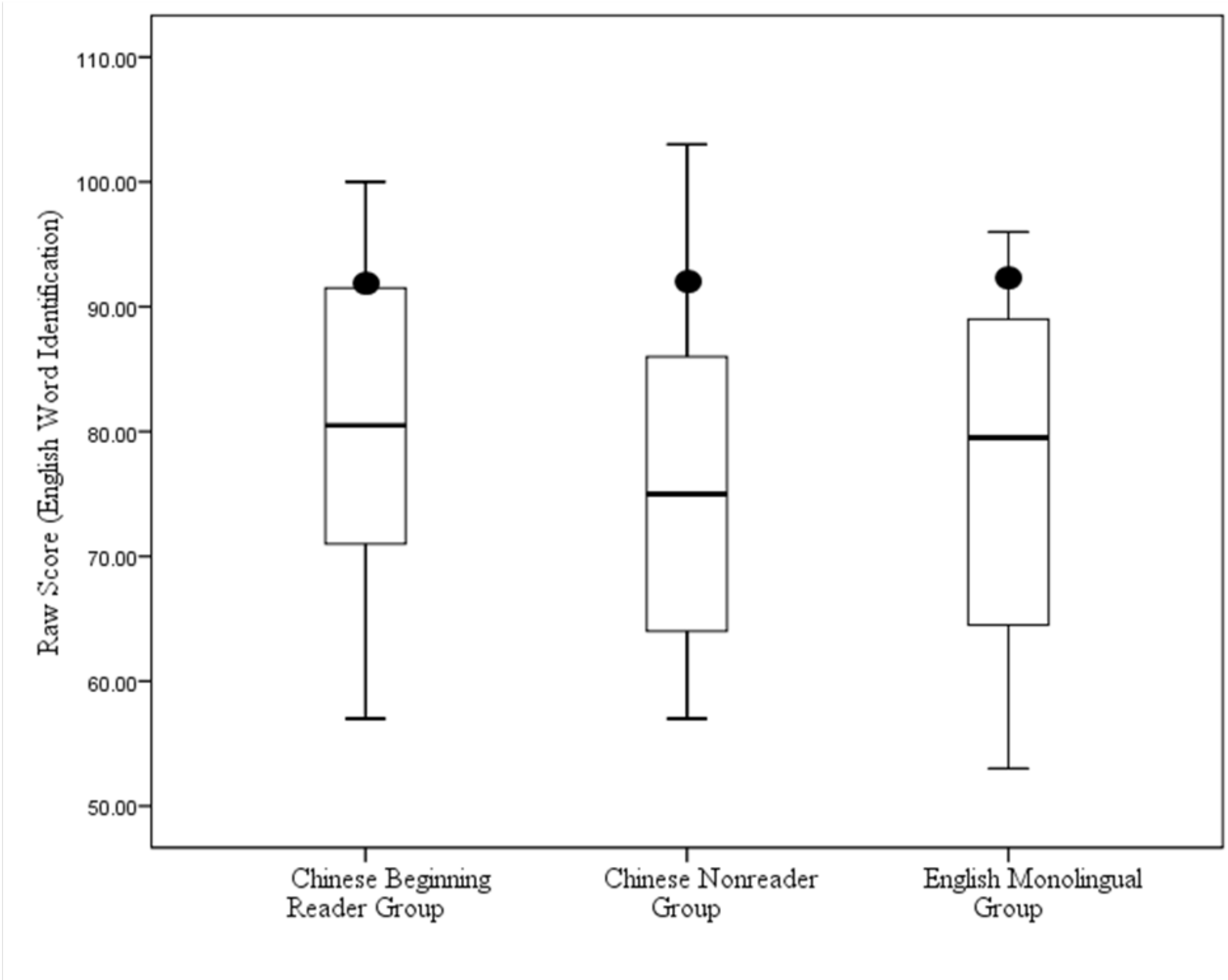

Figure 11. Box plot of the three groups' performance on the English Word Identification subtest of the Woodcock Reading Mastery Test-Revised (WRMT-R). The box represents the middle 50% of the data sample. The space between the box and the lower whisker represents the bottom 25% of the data sample, and the space between the box and the upper whisker represents the remaining 25% of the data sample. The solid black line within each box represents the median score in each group. The solid black dot indicates the Chinese Advanced Reader's score (91).

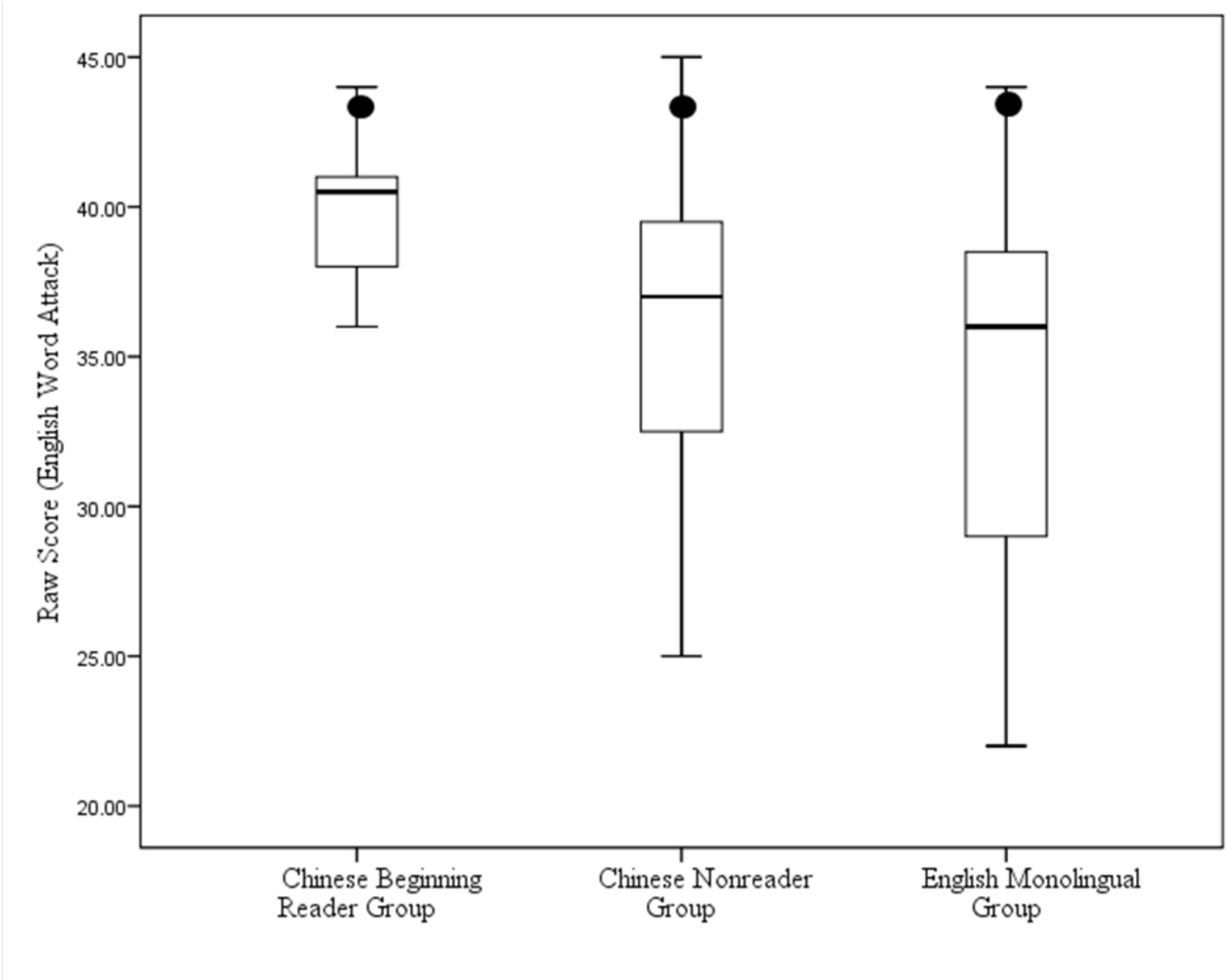

Figure 12. Box plot of the three groups' performance on the English Word Attack subtest of the Woodcock Reading Mastery Test-Revised (WRMT-R). The box represents the middle 50% of the data sample. The space between the box and the lower whisker represents the bottom 25% of the data sample, and the space between the box and the upper whisker represents the remaining 25% of the data sample. The solid black line within each box represents the median score in each group. The solid black dot indicates the Chinese Advanced Reader's score (43).

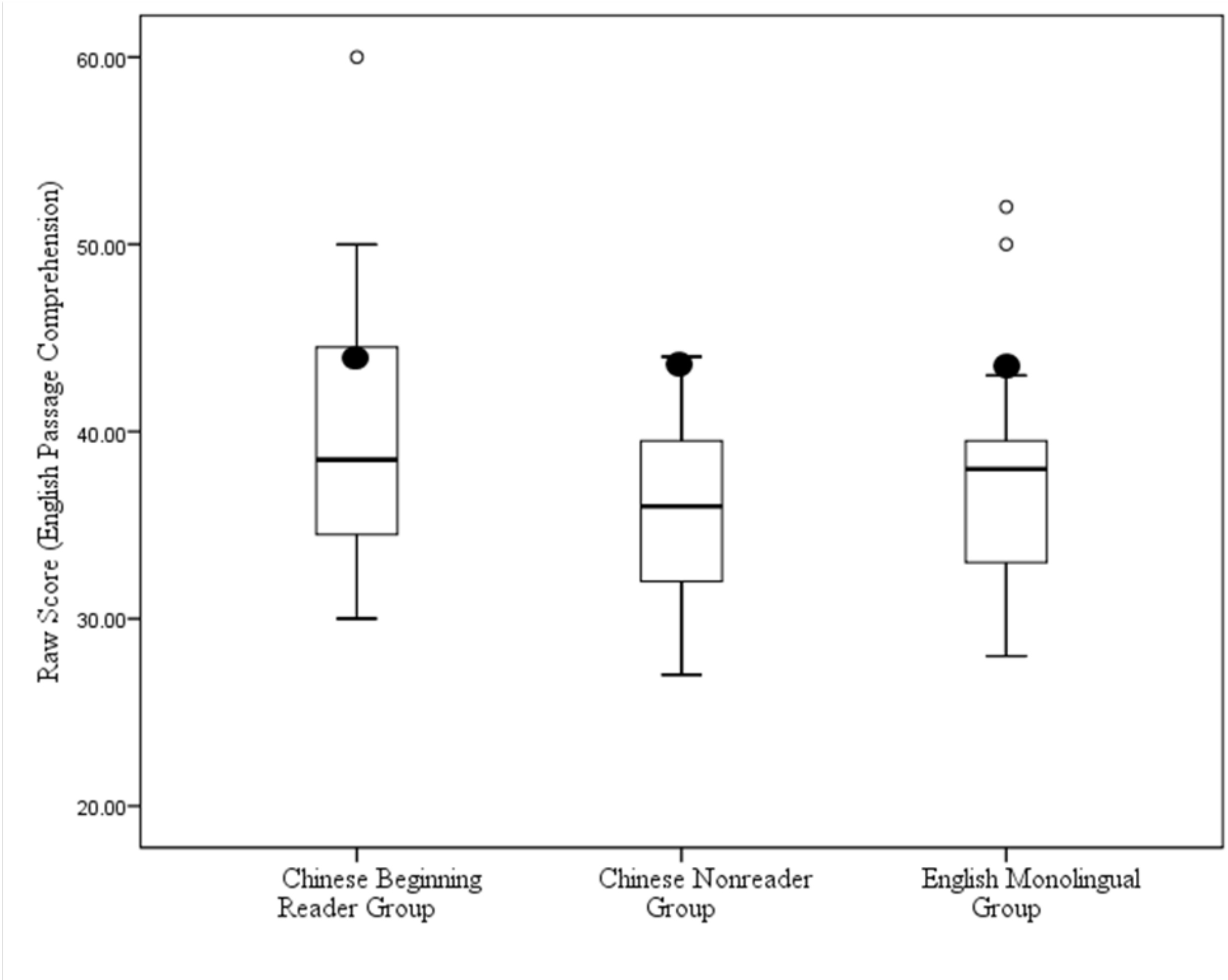

Figure 13. Box plot of the three groups' performance on the English Passage Comprehension subtest of the Woodcock Reading Mastery Test-Revised (WRMT-R). The box represents the middle 50% of the data sample. The space between the box and the lower whisker represents the bottom 25% of the data sample, and the space between the box and the upper whisker represents the remaining 25% of the data sample. The solid black line within each box represents the median score in each group. The solid black dot indicates the Chinese Advanced Reader's score (43). An open circle represents an outlier. An outlier is the score that falls beyond more than 1.5 box-length from the edge of the box.

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Appendix A

Language Background Survey

(Adapted from Gutierrez-Clellen & Kreiter, 2003 and Kovelman, Baker, & Petitto, 2008)

Today's date:_____________

Child's Information

1. Date of birth: _______________
2. Gender: ____________________
3. Grade: _____________________
4. School: ____________________
5. Place of birth: _______________
    i. If the place of birth is outside of the U.S., when did your child move to the U.S.?

    ii. If the place of birth is outside of the U.S., how long has your child lived in the U.S.?

6. At what age was your child **<u>first</u>** exposed to English? (Please circle one)
   Before age 3 3-4 years old 5-6 years old 7-8 years old

7. How long have your child learned to read and write in Chinese?

8. How long have your child learned to read and write in English?

9. Do you read with your child at home? (Please circle one) **Yes No**

   If yes, please circle all languages that apply.

   Chinese English Others: __________

Parents' Information

Father

10. Father's native language: _____________________
11. Highest level of education: _____________________
12. Occupation: ______________________
13. Currently enrolled in an educational program? If so, which program and what degree are you working on? _______________________________________

Mother

14. Mother's native language: _____________________
15. Highest level of education: _____________________
16. Occupation: ______________________
17. Currently enrolled in an educational program? If so, which program and what degree are you working on? _______________________________________

Appendix A (Continued)

Language Background Survey

18. Please use the following rating scale to indicate how well and how much one uses each language.

How well:

0 = Cannot speak the indicated language, has a few words or phrases, cannot produce sentences, only understands a few words.

1 = Cannot speak the indicated language, has a few words or phrases, understands the general idea of what is being said

2 = Limited proficiency with grammatical errors, limited vocabulary, understands the general idea of what is being said.

3 = Good proficiency with some grammatical errors, some social and academic vocabulary, understands most of what is said.

4 = Native-like proficiency with few grammatical errors, good vocabulary, understands most of what is said.

How often:

0 = Never speaks the indicated language, never hears it.

1 = Never speaks the indicated language, hears it very little.

2 = Speaks the indicated language a little, hears it sometimes.

3 = Speaks the indicated language sometimes, hears it most of the time.

4 = Speaks the indicated language all of the time, hears it all of the time.

	English		Mandarin	
	How often	How well	How often	How well
The Child				
Father				
Mother				
Other:				
Other:				
Other:				
Other:				

Appendix A (Continued)

Language Background Survey

<u>The following pages will be completed by the investigator</u>

19. Linguistic Profile of the Home

(A) Hours Mon. – Fri. (max. 12 hr/day for 5 days = 60 hrs.)			(B) Hours Sat. – Sun. (max. 17 hr/day for 2 days = 34 hrs.)			(C) Total No. of Hours with Each Person (Columns A + B)	(D) Person	(E) Language Spoken Child	(F) Child Responds to:
Hrs.	Days	Total	Hrs.	Days	Total				

Note: Mon. = Monday, Fri. = Friday, Sat. = Saturday, Sun. = Sunday, Max. = Maximum, Hr = Hour, Hrs. = Hours, No. = Number

19. Interview Questions:

a) Who does the child spend time with every week? (Fill in Column D)

b) Excluding the hours when the child is asleep or at school, how many hours during the <u>weekdays</u> does the child spend with each person? And how many times per week? (Fill in Column A)

c) Excluding the hours when the child is asleep or at school, how many hours during the <u>weekends</u> does the child spend with each person? And how many times per week? (Fill in Column B)

d) Which language does __________ (the person in Column D) speak to the child in? (Fill in Column E)
M = Mandarin, E = English, Mix = mixes the two languages within a conversation,
S = only speaks one language at a time.

e) Which language does the child respond in? (Fill in Column F)

Appendix A (Continued)

Language Background Survey

20. The Child's Years of Language Exposure to the Language(s)

Interview Questions: "What language(s) was your child exposed to at the age of ____?"

	Ages	At Home	At School/Preschool/ Daycare
Language Use			
	0-1	M: ____ E:____ O:_____	M: ____ E:____ O:_____
	1-2	M: ____ E:____ O:_____	M: ____ E:____ O:_____
	2-3	M: ____ E:____ O:_____	M: ____ E:____ O:_____
	3-4	M: ____ E:____ O:_____	M: ____ E:____ O:_____
	4-5	M: ____ E:____ O:_____	M: ____ E:____ O:_____
	5-6	M: ____ E:____ O:_____	M: ____ E:____ O:_____
	6-7	M: ____ E:____ O:_____	M: ____ E:____ O:_____
	7-8	M: ____ E:____ O:_____	M: ____ E:____ O:_____
	8-9	M: ____ E:____ O:_____	M: ____ E:____ O:_____
	9-10	M: ____ E:____ O:_____	M: ____ E:____ O:_____
Total number of years in Both ____; Mandarin ____; English ____			

Note: M = Mandarin; E = English; O = Others

The questions in this survey were adapted from the following two studies:

1. Gutierrez-Clellen, V., & Kreiter, J. (2003). Understanding child bilingual acquisition using parent and teacher reports. *Applied Psycholinguistics, 24,* 267-288.
2. Kovelman, I., Baker, S. A., Petitto, L. A. (2008). Age of first bilingual language exposure as a new window into bilingual reading development. *Bilingualism: Language and Cognition, 11 (2),* 203-233.

Appendix B

Mandarin Onset-Rime Matching Task

Instruction: Say to the child, "You will hear three Mandarin sounds. Please listen carefully. Listen carefully to <u>the beginning/end of the sound</u> and tell me which one sounds different from the one in the middle. You can ask for repetition if you want to hear the sounds again. Now let's practice on some items."

Training Trials:

	A (Candidate)	X (Target)	B (Candidate)
1. rime matching	美 beautiful [me3]	尾 tail [we3]	擠 crowded [tɕɪ3]
2. onset matching	扛 carry [kʰaŋ2]	爬 crawl [pʰa2]	皮 skin [pʰɪ2]
3. rime matching	活 live [xuɔ2]	國 country [kuɔ2]	來 come [laɪ2]

Note. The number indicates one of the four tones in Mandarin.

Key: A, B, A

Testing Trials

Matching	A (Candidate)	X (Target)	B (Candidate)	Key
1. Rime	媽 mother [ma1]	拉 to pull [la1]	出 out [tʂʰu1]	A
2. Onset	哭 to cry [kʰu1]	單 single [tɑn1]	搭 to build [tɑ1]	B
3. Onset	帥 handsome [ʂwɑɪ4]	爍 to blink [ʂwɔ4]	訴 to tell [su4]	A

Appendix B (Continued)

Mandarin Onset-Rime Matching Task

Testing Trials (continued)

Matching	A (Candidate)	X (Target)	B (Candidate)	Key
4. Rime	夜 night [jɛ4]	照 to shine on [tʂɑʊ4]	靠 depend on [kʰɑʊ4]	B
5. Onset	棋 chess [tɕʰɪ2]	琴 piano [tɕʰjən]	如 if [ɹu2]	A
6. Rime	扣 discount [kʰo4]	路 road [lu4]	木 wood [mu4]	B
7. Onset	奴 slave [nu2]	娘 mother [njaŋ2]	羅 to arrange [luɔ2]	A
8. Onset	左 left [tsuɔ3]	早 early [tsɑʊ3]	採 to pick [tsʰɑɪ3]	A
9. Rime	條 to adjust [tʰjɑʊ2]	學 to study [ɕyɛ2]	覺 to feel [tɕyɛ2]	B
10. Rime	厚 thick [xo4]	掛 to hang [kuA4]	話 words [xuA4]	B
11. Rime	繩 rope [ʂŋ2]	提 to carry [tʰɪ2]	急 hurry [tɕɪ2]	B
12. Onset	低 low [tɪ1]	夫 husband [fu1]	翻 to flip [fɑn1]	B
13. Onset	追 to chase [tʂue1]	婚 marriage [xuən1]	呼 to breathe [xu1]	B
14. Onset	胚 embryo [pʰe1]	縮 shrink [suɔ1]	三 three [sɑn1]	B

Appendix B (Continued)

Mandarin Onset-Rime Matching Task

Testing Trials (continued)

Matching	A (Candidate)	X (Target)	B (Candidate)	Key
15. Rime	耐 to endure [nɑɪ4]	賽 game [sɑɪ4]	破 to break [pʰɔ4]	A
16. Onset	百 hundred [pɑɪ3]	飽 full [pɑʊ3]	乳 milk [ɹu3]	A
17. Rime	命 life [mjŋ4]	六 six [ljo4]	嗅 sniff [ɕo4]	B
18. Onset	離 to leave [lɪ2]	球 ball [tɕʰjo2]	瘸 to limp [tɕʰyɛ2]	B
19. Rime	伯 uncle [pɔ2]	殼 shell [kʰɤ2]	格 square [kɤ2]	B
20. Rime	臭 smelly [tʂʰo4]	肉 meat [ɹo4]	罵 to scold [mA4]	A

Appendix C

Mandarin Tone Matching Task

Instruction: Say to the child, "You will hear three Mandarin sounds. Please listen carefully to the tone of each sound and tell me which one shares the same tone with the sound in the middle. You can ask for repetition if you want to hear the sounds again. Now let's practice on some items."

Training Trials:

	A (Candidate)	X (Key)	B (Candidate)
1.	乳 milk [ɹu3]	我 I [uɔ3]	學 to learn [ɕyɛ2]
2.	時 time [ʂ2]	店 shop [tjɑn4]	價 price [tɕjA4]
3.	千 thousand [tɕʰjɑn1]	擦 to erase [tsʰA1]	同 same [tʰuŋ2]

Note. The number indicates one of the four tones in Mandarin.

Answers: A, B, A

Testing Trials:

Mathing	A (Candidate)	X (Target)	B (Candidate)	Key
1. tone 1	開 to open [kʰɑɪ1]	單 single [tɑn1]	路 road [lu4]	A
2. tone 3	或 or [xuɔ4]	數 to count [ʂu3]	米 rice [mɪ3]	B
3. tone 2	聊 to chat [ljɑʊ2]	平 flat [pʰjŋ2]	入 to enter [ɹu4]	A
4. tone 3	有 existence [jo3]	鳥 bird [njɑʊ3]	藏 treasure [tsaŋ4]	A

Appendix C (Continued)

Mandarin Tone Matching Task

Testing Trials (continued)

Matching	A (Candidate)	X (Target)	B (Candidate)	Key
5. tone 4	將 will [tɕjaŋ1]	下 below [ɕjA4]	易 easy [ɪ4]	B
6. tone 1	受 to suffer [ʂo4]	鋼 steel [kaŋ1]	西 west [ɕɪ1]	B
7. tone 3	清 clear [tɕʰjŋ]	窄 narrow [tʂɑɪ3]	火 fire [xuɔ3]	B
8. tone 2	壺 pot [xu2]	肥 fat [fe2]	弱 weak [ɹuɔ4]	A
9. tone 2	句 sentence [tɕy4]	兒 son [ɚ2]	人 people [ɹən2]	B
10. tone 1	草 grass [tsʰɑʊ3]	燈 light [təŋ1]	飛 fly [fe1]	B
11. tone 3	形 shape [ɕjŋ2]	雨 rain [y3]	比 to compare [pɪ3]	B
12. tone 4	妹 sister [me4]	月 moon [yɛ4]	彎 to bend [uɑn1]	A
13. tone 2	滿 full [mɑn3]	濁 unclear [tʂuɔ2]	杓 spoon [ʂɑʊ2]	B
14. tone 1	落 to drop [luɔ4]	資 money [ts1]	區 area [tɕʰy1]	B

Appendix C (Continued)

Mandarin Tone Matching Task

Matching	A (Candidate)	X (Target)	B (Candidate)	Key
15. tone 4	唱 to sing [tʂʰaŋ4]	做 make [tsuɔ4]	沒 none [me2]	A
16. tone 3	貼 to stick [tʰjɛ1]	虎 tiger [xu3]	狗 dog [ko3]	B
17. tone 1	跌 to fall [tjɛ2]	春 spring [tʂʰuən1]	消 to cancel [ɕjɑʊ1]	B
18. tone 4	想 to think [ɕjaŋ3]	快 fast [kʰuɑɪ4]	變 to change [pjɑn4]	B
19. tone 4	危 danger [ue2]	寄 to mail [tɕɪ4]	正 square [tʂəŋ4]	B
20. tone 2	親 intimate [tɕʰjən1]	軸 axis [tʂo2]	容 to allow [ɹuŋ2]	B

Appendix D

English Onset-Rime Matching Task

Instruction: Say to the child, "You will hear three English-like words. Please listen carefully to the beginning/end of the sounds and tell me which sound is different from the one in the middle. You can ask for repetition if you want to hear the sounds again. Now let's practice on some items."

Training Trials:

	A (Candidate)	X (Target)	B (Candidate)
1. rime matching	rint [rɪnt]	bisk [bɪsk]	kisk [kɪsk]
2. onset matching	rift [rɪft]	rapt [rɑpt]	sikt [sɪkt]
3. rime matching	teg [tɛg]	zeg [zɛg]	pab [pɑb]

Testing Trials

Matching	A (Candidate)	X (Target)	B (Candidate)	Key
1. Rime cvc	siv [sɪv]	tiv [tɪv]	meb [mɛb]	A
2. Onset cvc	nis [nɪs]	mar [mar]	mib [mɪb]	B
3. Onset cvcc	kask [kæsk]	runt [rʌnt]	relf [rɛlf]	B
4. Rime ccvc	bloz [blɔz]	fleb [flɛb]	preb [prɛb]	B
5. Onset cvc	tup [tup]	sig [sɪg]	sud[sʌd]	B
6. Rime ccvcc	bleft [blɛft]	spomp [spomp]	fromp [fromp]	B
7. Onset ccvc	plof [plɔf]	pruce [prus]	stez [stɛz]	A
8. Onset ccvcc	glift [glɪft]	swungs[swʌŋz]	skonk [skɔnk]	B

Appendix D (Continued)

English Onset-Rime Matching Task

Testing Trials (continued)

Matching	A (Candidate)	X (Target)	B (Candidate)	Key
9. Rime cvc	kel [kɛl]	vag [væg]	sag [sæg]	B
10. Rime ccvc	slung [slʌŋ]	broob [grʊb]	bloob [blʊb]	B
11. Rime ccvcc	bramp[bræmp]	twend[twɛnd]	thrend[ɵrɛnd]	A
12. Onset cvc	bod [bod]	mif [mɪf]	mag [mæg]	B
13. Onset cvcc	gounth [gɔnɵ]	kunz [kʌvz]	kathed [kæðd]	B
14. Onset ccvc	snook [snʊk]	smung [smʌŋ]	bloth [blɔð]	A
15. Rime cvcc	gind [gɪnd]	naft [næft]	waft [wæft]	B
16. Onset ccvcc	glamt [glæmt]	granz [grænz]	frund [frʌnd]	B
17. Rime cvcc	pilp [pɪlp]	lomf [lɔmf]	fomf [fɔmf]	B
18. Onset cvcc	ranzd [ræzd]	relz [rɛlz]	molp [mɔlp]	A
19. Rime ccvc	truge [truʒ]	plev [plɛv]	swev [swɛv]	B
20. Rime ccvcc	tregs [trɛgz]	snelps [snɛlps]	prelps [prɛlps]	B

Appendix E

English Final Phoneme Matching Task

Instruction: Say to the child, “You will hear three English-like words. Please listen carefully to the end of the sound and tell me which one is different from the one in the middle. You can ask for repetition if you want to hear the sounds again. Now let’s practice on some items.”

Training Trials:

	A (Candidate)	X (Target)	B (Candidate)
1.final phoneme matching cvcc	fmp [fɪmp]	sast [sæst]	fershet [fɚʃɛt]
2. final phoneme matching cvc	Riv [rɪv]	sev [sɛv]	thab [Ɵɛb]
3. final phoneme matching cvc	lood [lʊd]	perd [pɚd]	chig [ʧɪg]

Key: B, A, A

Testing Trials

Matching	A (Candidate)	X (Target)	B (Candidate)	Key
1. final phoneme cvc	jaith [ʒeƟ]	lath [læƟ]	pib [pɪb]	A
2. final phoneme cvc	loam [lom]	phic [fɪk]	puk [pʊk]	B
3. final phoneme cvcc	shelz [ʃɛlz]	ganz [gænz]	mugd [mægd]	A
4. final phoneme ccvc	stid[stɪd]	cluf [clʌf]	drouf [druf]	B
5. final phoneme cvc	seb [sɛb]	vil [vɪl]	gool [gul]	B
6. final phoneme cvcc	fump [fʌmp]	solp [solp]	doupt [daʊpt]	A
7. final phoneme ccvc	klooth [klʊƟ]	snig [snɪg]	froug [fraʊg]	B

Appendix E (Continued)

English Final Phoneme Matching Task

Testing Trials (continued)

Matching	A (Candidate)	X (Target)	B (Candidate)	Key
8. final phoneme ccvcc	klingt [klɪŋt]	brakt [brækt]	smalf [smælf]	A
9. final phoneme cvc	weg [wɛg]	dop [dap]	lup [lʌp]	B
10. final phoneme cvcc	naingth [neŋð]	moost [mʊst]	chaept [ʧept]	B
11. final phoneme ccvc	driv [drɪv]	stush [stʌʃ]	clash [klæʃ]	B
12. final phoneme cvc	kas [kas]	rup [rʌp]	laip [lep]	B
13. final phoneme ccvc	sloum [slaʊm]	greem [grim]	blap [blæp]	A
14. final phoneme cvcc	belk [kɛlk]	roulk [raʊlk]	koopt [rʊpt]	A
15. final phoneme cvcc	hoank [hoŋk]	wouks [waʊks]	vaps [væps]	B
16. final phoneme ccvcc	smilp [smɪlp]	floomp [flump]	breank [brɛŋk]	A
17. final phoneme ccvc	slutch [slʌʧ]	fratch [fræʧ]	wint [wɪnt]	A
18. final phoneme ccvcc	dronz [drɔŋz]	spealz [spɛlz]	plakt [plækt]	A

Appendix E (Continued)

English Final Phoneme Matching Task

Matching	A (Candidate)	X (Target)	B (Candidate)	Key
19. final phoneme ccvcc	thrupt [Ɵrʌpt]	plork [slɔrk]	grask [græsk]	B
20. final phoneme ccvcc	clouft [klaʊft]	Breahld[brɛld]	Swind [swɪnd]	B

Appendix F

Chinese Reading Comprehension Test

(Adapted from Lo, 2006b)

Passage 1:

媽媽看照片，常常一邊看一邊笑。我問媽媽:「照片裡有什麼?」媽媽說:「照片裡有很多你成長的小故事。」

媽媽指著一張照片說:「這是你一歲生日時拍的，看你滿臉的奶油，多可愛呀!」

接著，媽媽又拿起一張照片說:「這是四歲的你，最愛學大人了。看你抱著公事包，腳上穿著爸爸的大皮鞋，真是有趣。」

我指著一張照片說:「這是去年開學那天，媽媽幫我拍的。我坐在校車裡，穿著新衣服，背著新書包，頭抬得高高的，好神氣!」

從照片裡，可以看到我的成長，也可以看到我小時候的故事。所以，我最喜歡和媽媽一起看照片。

1. 為什麼寫這篇文章的小朋友喜歡看媽媽一起看照片?
   1) 因為照片裡有他小時候成長的小故事。
   2) 因為照片裡有可愛的小動物。
   3) 因為他喜歡照相。
   4) 因為他可以邊看照片邊吃蛋糕。

2. 媽媽說這位小朋友四歲的時候最喜歡做什麼?
   1) 吃蛋糕。
   2) 學大人。
   3) 背書包。
   4) 看照片。

3. 開學那一天的照片是在那裡拍的?
   1) 家門口。
   2) 教室裡。
   3) 校門口。
   4) 校車裡。

4. 一歲生日時這位小朋友臉上塗滿什麼?
   1) 巧克力。
   2) 果醬。
   3) 奶油。
   4) 牛奶。
   5)

5. 開學第一天這位小朋友怎麼去上學?
   1) 走路。
   2) 搭校車。
   3) 媽媽送他去學校。
   4) 騎腳踏車。

Appendix F (Continued)

Chinese Reading Comprehension Test (English Translation)

(Adapted from Lo, 2006b)

Passage 1:

Mommy always looks at pictures with big a smile. I asked her, "What did you see in the pictures?" Mommy said, "There are many stories of you when you are growing up."

Mommy pointed to a picture and said, "This picture was taken when you had your first-year birthday. Your face was covered with whipped cream. You looked so cute!"

Then mommy picked up another picture and said, "This was taken when you were four years old. You loved to imitate adults at that time. You held a suitcase and wore daddy's big shoes. It's so interesting."

I pointed to another picture and said, "This was taken last year when school started. Mommy took the picture for me. I was sitting in the school bus, wearing new clothes and carrying new backpack with my head lifted high. I looked so proud of myself."

From those pictures, I can see how I grew up and know my own stories. Therefore, I love to look at pictures with my mom.

1. Why did this child love to look at pictures with his mom?
    1) Because the pictures contain many childhood stories of his.
    2) Because there are many small animals in the pictures.
    3) Because he likes to take pictures.
    4) Because he can eat cakes when looking at the pictures.
2. According to his mom, what did the author enjoy doing when he was four years old?
    1) Eating cakes.
    2) Imitating adults.
    3) Carrying backpacks.
    4) Looking at pictures.
3. Where was the picture taken on his first day of school?
    1) In front of his house.
    2) In the classroom.
    3) In front of the school gate.
    4) In the school bus.
4. What covered the child's face when he had his first-year-old birthday?
    1) Chocolate.
    2) Jelly.
    3) Whipped cream.
    4) Milk.
5. How did the child go to school on his first day of school?
    1) He walked.
    2) He took a school bus.
    3) His mom rode him to school.
    4) He rode his bike.

Appendix F (Continued)

Chinese Reading Comprehension Test
(Adapted from Lo, 2006a)

Passage 2:

有一隻狗咬著一塊肉，他心裡很快樂，想找個地方好好的享受。

他走到木橋上，看見河裡也有一隻狗，咬著一大塊肉。他很貪心，想吃那塊肉，就跳進水裡。

可是，河裡的那隻狗不見了。這隻貪心的狗，不但沒有吃到那塊肉，連自己咬的肉也被水沖走了。

1. 這隻狗為什麼要跳進水裡?
   1) 因為天氣熱，他想跳進水裡洗澡。
   2) 因為他看見河裡也有一隻狗咬著一大塊肉，他想吃那塊肉。
   3) 因為他看見河裡也有一隻狗，他想和他一起玩。
   4) 因為他的肉掉到河裡了，他要跳進去撿。

2. 河裡的狗為什麼不見了?
   1) 因為這隻狗其實是看到自己在水裡的倒影。
   2) 因為他被這隻狗嚇跑了。
   3) 因為他跳上木橋了。
   4) 因為他被水沖走了。

3. 最後這隻狗有吃到肉嗎?
   1) 有，他吃了兩塊肉。
   2) 沒有，他的肉被水沖走了。
   3) 有，他只吃到自己原本咬的那塊肉。
   4) 有，他搶到另一隻狗嘴裡咬的肉。

4. 請選出適合這篇短文的標題:
   1) 貪心的狗。
   2) 被水沖走的肉。
   3) 木橋上的狗。
   4) 河裡的兩隻狗。

5. 這隻狗最後感覺一定很
   1) 高興。
   2) 懊惱。
   3) 害怕。
   4) 驚訝。

Appendix F (Continued)

Chinese Reading Comprehension Test (English Translation)

(Adapted from Lo, 2006a)

Passage 2:

A dog was holding a piece of meat in his mouth. He felt so happy and wanted to find a place to enjoy his meal.

He walked through a wood bridge. He saw there was another dog in the river. He found the dog also hold a piece of meat in the mouth. He was greedy. He wanted to eat that piece of meat. Therefore, he jumped into the river.

However, the dog in the river disappeared. This greedy dog did not eat any pieces of meat. His own piece of meat was flushed away by the river.

1. Why did this dog jump into the river?
   1) It was too hot so he wanted to take a shower in the river.
   2) He saw a dog holding a piece of meat in the river. He wanted to get that piece of meat.
   3) He wanted to play with the dog in the river.
   4) He dropped his piece of meat into the river.

2. Why did the dog in the river disappear?
   1) There was no dog in the river. The dog actually saw his own reflection in water.
   2) He was scared so he ran away.
   3) He jumped up to the wood bridge.
   4) He was flushed away by the river.

3. Did this dog eventually eat anything?
   1) Yes, he ate two pieces of meat.
   2) No, his piece of meat was flushed away by the river.
   3) Yes, he only got to eat his own piece of meat.
   4) Yes, he took a piece of meat from the other dog.

4. Please choose an appropriate title for this passage:
   1) The greedy dog.
   2) The meat flushed away by the river.
   3) The dog on the bridge.
   4) Two dogs in the river.

5. At the end, this dog must feel
   1) Happy.
   2) Regretful.
   3) Scared.
   4) Surprised.

Appendix G

Guidelines for English Narrative Sample Transcription

(Adapted from Miller & Iglesias, 2008; Watkins, 2005)

Procedures of Entering a Transcript

1. Open a new file
2. Fill out “Header Information” everything except for parent education and subgroup
3. Put the “Narrative File Number” and the “length of recording” in “Other Header Information”
4. Click “Check” for any errors
5. Click “OK”
6. Type in a transcript
7. Check for transcript-entry errors by clicking the red check icon. Correct the errors. Use the next error icon to see the next error.
8. Save the file:
    a. Save one in the folder named “Fang-Ying” on the desktop
    b. Save another one in the flash drive

Transcription Conventions

Utterance

1. Communication Units (C-units) are defined as “an independent clause and its modifiers” (Loban, 1976). One utterance means one complete thought.

    a. Main clause: a clause that can stand alone as a complete sentence.
    b. Subordinate clause: subordinate clauses depend on the main clause to make sense. Subordinate clauses cannot stand alone.

    ➔ So a c-unit will either consist of a main clause or a main clause with its subordinating clauses.

    ➔ E.g., The boy put the frog in a jar when he went to sleep.
    Main clause subordinate clause
    So when transcribing this sentence, count it as ONE utterance:
    C The boy put the frog in a jar when he went to sleep.

    c. Two types of conjunctions are used to link clauses: Coordinating and Subordinating conjunctions.

    ➔ **Coordinating Conjunctions** (i.e., and, or, but) usually link two main clauses so the sentences can be segmented into TWO utterances.
    - E.g., The frog was sitting on a lily pad and then it jumped in.
      C The frog was sit/ing on a lily pad.
      C And then it jump/ed in.

    - E.g., He climbed up on the branches but they weren’t branches.
      C He climb/ed up on the branch/s.
      C But they were/n’t branch/s.

Appendix G (Continued)

Guidelines for English Narrative Sample Transcription

➔ **Subordinating Conjunctions** (i.e., because, that, when, who, after, before, so (that), which, although, if, unless, while, as, how, until, as…as, like, where) link a main clause and a subordinate clause. So the sentence with a subordinating conjunction will be counted as ONE utterance.

- E.g., He looked in the woods because the frog was hiding.
  C He look/ed in the wood/s because the frog was hide/ing.

- E.g., He is the boy who ran away.
  C He is the boy who ran away.

2. Direct quotes in or as part of an utterance are counted as one C-unit.
   e.g., C And the boy told him, "That is my frog".

   Continued main clauses that occur in direct quotes are counted as TWO C-units.
   e.g., C And he said, "I am ready".
   C "I want to go to the store now".

3. Count utterances which are not grammatically correct as a C-unit.
   e.g., C "The polices came".

4. Include one and two word utterances in the sample.
   e.g., E Did anybody notice that he is leaving?
   C No.

5. Use period/question mark to end an utterance.

6. Do not press the <enter> key until the end of the utterance.

7. Each utterance should start on a new line. Do not put more than one utterance on a line. Do not put anything after the ending punctuation.
   a. e.g., We went shopping. [Mandarin] *Incorrect*
   b. e.g., We went shopping [Mandarin]. *Correct*

8. Do not use a period for abbreviations.
   a. e.g., I live on Griggs St. now. *Incorrect*
   b. e.g., I live on Griggs St now. *Correct*

9. Abandoned Utterance: use > for after an abandoned utterance when the speaker voluntarily stops in mid-utterance. No period after >
   e.g., do you think >

Appendix G (Continued)

Guidelines for English Narrative Sample Transcription

Interrupted Utterance: use ^ for an interrupted utterance when the speaker got interrupted by the examiner or another person. Do not put a period after ^

e.g., C Then he went^
E Where did he go?
C He went to another town.

Overlapping Speech: use <> to enclose overlapping speech. A period is needed to end the utterance.

e.g., E Look at his <neighbor>.
C <He is leaving> the town.

10. Do not break a verb compound.
    e.g., Fred went to a random car and went down the bridge. ← count this as one utterance.

Word

11. Word: "The Flower Man" is counted as one word and transcribed as the_flower_man
    Counted as one word: for_sale; lots (don't mark *s* as a bound morpheme). "The flower man" and "for sale" are written in the book so we don't count them as separate words. However, for other words, count each word as a separate unit.

12. Incomplete Word: If a speaker stutters or fails to complete a word, enter the portion of the word you can discern followed by an asterisk (*).
    e.g., I like Gramma_ (j* j*) _Jones because she give/3s me can_ (d*) _dy.
    e.g., He gave her a (f* f* f*) flower.

Morphemes

13. Bound Morphemes: root word/bound morpheme (use the root word followed by a slash "/" and then the bound morpheme)

    a. Regular plurals: /s (flowers = flower/s, cities = city/s, dishes = dish/s) Do not mark those words that do not have singular forms (e.g., in the woods = in the woods, in his pants = in his pants, downstairs = downstairs)

    b. Possessives: /z (e.g., Mark's = Mark/z). Do not mark possessive pronouns (i.e., hers = hers, ours = ours, his = his)

    c. Plural Possessives: /s/z (e.g., teachers' = teacher/s/z; babies' = baby/s/z)

    d. 3rd person singular: /3s (e.g., he looks at him. = he look/3s at him.)

Guidelines for English Narrative Sample Transcription

e. Progressive: /ing. Only mark *ing* when it indicates ongoing action. (e.g., He is running. = He is run/ing.)

f. Regular past tense: /ed (e.g., The baby cried. = The baby cry/ed.)

- Do not mark irregular verb forms or concatenatives as inflections (use DOES, GONNA, etc).

- Words that contain a bound morpheme but is used as an adjective should be transcribed without a slash.
  - E.g., scrambled egg; running dog

- Don't mark overgeneralized or incorrect use of bound morphemes. Instead, mark it as an error.
  - E.g., He goed to school. → He goed[EWV:went] to school.
  - E.g., The polices came. → The polices[EWP:police] came.

- Predicate adjectives are not marked as inflections
  - e.g., I am tired.

- Don't mark passive voice.
  - E.g., He was trapped.

- Don't mark present perfect forms.
  - E.g, I have lived in it.

- Do not mark gerunds as inflections
  - E.g., Swimming is fun.
  - E.g., He went shopping.
  - E.g., <u>The tree started growing → The tree start/ed growing</u>.
  - E.g., He was busy preparing for food.

    - Do not use the slash / symbol for WON'T, DON'T, AIN'T and LET'S.

Appendix G (Continued)

Guidelines for English Narrative Sample Transcription

- To mark the speaker's failure to use a bound morpheme in an obligatory context, insert the bound morpheme slash followed immediately by an asterisk (/*) and then type the omitted bound morpheme.
  - (He walk there) → He walk/*ed there.

- If you cannot determine the tense of an utterance based on the context, don't mark anything. Not necessary to mark it as a missing bound morpheme.
  - E.g., The bird fly. → The bird fly.

Maze

14. Mazes are reformulations, repetitions, false starts and filled pauses. Mark mazes in parentheses (). <u>When mazes are removed, the remaining words can stand alone</u>.

    a. Filled pause (FP) words such as UM and ER are marked as mazes. e.g., He went (um [FP]) shopping.

    b. If a child uses fillers such as *<u>like</u>*, *<u>you know</u>*, *<u>well</u>* too much throughout their narrative, we need to maze them. Otherwise, do not maze fillers.
    e.g., He's like very angry. → He/'s like very angry.
    e.g., Like he's like very mad and like upset about her. → (Like[FP]) he/'s (like[FP]) very mad and (like[FP]) upset about her.

    ** If you consider "like, you know, well" as filler, make sure to maze it and put [FP] after the word, same as you do for "*um* or *huh*".

    c. Do not mark words repeated for emphasis. The first use of each word in the repetition is transcribed normally. Words repeated more than once are linked by the underscore.

    1) C The dog ran ran.
    2) C The dog ran ran_ran.
    3) C The dog ran very very_very fast.
    4) C Dijeron rana rana_rana dónde estás.
    5) C They looked everywhere and everywhere_everywhere.
    6) C They looked everywhere and everywhere_and_everywhere.

15. If the reformulation is an unrelated thought, count it as a new utterance rather than mazing.
    E.g., The little girl was really happy.
    His neighbor/s were really happy.

Appendix G (Continued)

Guidelines for English Narrative Sample Transcription

16. Do not maze self talk.
    E.g., They all became colorful I mean not everybody Only those who got flowers all became colorful.
    → They all became colorful.
    I mean not everybody.
    Only those who got flower/s all became colorful.

Spelling Conventions

17. Spell every shortened words and abbreviations
    e.g., Mr. will be transcribed as mister
    e.g., if the child says “cuz”, we still need to transcribe it as “because”
    e.g., em → them
    e.g., bout → about
    e.g., kinda → kind of

    <u>Spelling for vocalizations with specific meanings</u>
    Hmm (indicate question or affirmation)
    Huh (request clarification)
    Mhm, Uhhuh or AHA (indicate yes)
    Mhmh, Uhuh or Ahah (indicate no)
    Shh or %Shh (% indicates sound effect)
    Uh (indicate hesitation; in the process of thinking what to say)

    <u>Other Common Spellings</u>
    Yeah
    Okay
    Um
    Gonna
    Don’t
    Hey
    Let’s
    Nope
    Wanna
    Bathtub

Appendix G (Continued)

Guidelines for English Narrative Sample Transcription

Codes

18. Code: Mark Mandarin words as [Mandarin].

19. Mark verb error as [EWV]: Error at word level Verb; plural error as [EWP]: Error at word level plural
    e.g., The house was torned[EWV:torn].
    e.g., The peoples[EWP:people] came to his house.
    e.g., The polices[EWP: police] came.

    Note: The errors above were overgeneralizations so we don't mark *ED* and *S* as bound morphemes. Instead, we mark them as errors. However, when the child failed to mark past tense ED or plural S in an obligatory context, we put an asterisk before *ED* and *S* (As discussed in the Bound Morpheme Section).
    - e.g., *The Boy go/*3s here. (child said "Boy go here")

20. Mark gender error as [EWG]: Error at word level gender
    e.g., The_flower_man gave a flower to the girl.
    He[EWG: she] took the pink flower and walk/ed away.

Others

21. Unintelligible Speech: If you cannot understand a speaker's utterance after listening to it three times, consider it to be partly unintelligible or completely unintelligible and mark the unintelligible segment with X's.
    e.g., C He X for the class.
    C He X for the Xer.

    If the entire utterance is unintelligible, use XXX.
    C He XX.

22. If there is one unintelligible word, you can make a guess based on the context if possible.
    e.g., The robber falls in love with the fat xx.
    → The robber fall/3s in love with the fat woman.

23. Transcriber's comments
    a. Comments within utterances
       C Then the guy is still in the bathtub {C laughs}.
    b. Use comment lines for information may be included for clarification.
       = Child talks softly and there's a lot of background noise.
       C Then he x for xx.
       C Then xxer.

Appendix G (Continued)

Guidelines for English Narrative Sample Transcription

24. Do not mark more than two omitted words or bound morphemes in an utterance. Instead, mark the entire utterance as having a problem by inserting code [EU].
    e.g., The flower man a house sale.
    Instead of fixing it to be “The_flower_ma *saw a house *for_sale”, just transcribe it as “The flower man a house sale[EU].”

Appendix H

Guidelines for Mandarin Narrative Sample Transcription

Utterance Segmentation

1. Subject omission: Mandarin is a pro-drop language in which subject can be omitted if the context provides sufficient information for determination of the subject. For example: 他找到一個房子, 然後很想買。(He found a house, and [he] wanted to buy [it].)
   There are two possible ways to transcribe this sentence:
   *Child: 他找到一個房子, 然後很想買。(He found a house and wanted to buy [it].)
   Or
   *Child: 他找到一個房子。(He found a house.)
   *Child: 然後很想買。(And [He] wanted to buy [it].)
   If a situation like this arises, the child's intonation or pause will be used to determine utterance boundary. If the child pauses or the intonation drops after "He found a house", then an utterance boundary will be drawn between "He found a house" and "and [he] wanted to buy [it]." If there is no pause or no intonation drop, one utterance will be transcribed.

2. Repetitions: Direct repetitions of the author's utterance or word will be excluded. For example:
   *Child: 這個老人走到了一個 *how do you say town*? (This old man came to a *how do you say town*?)
   *Examiner: 城鎮。(Town.)
   *Child: 城鎮。(Town.)
   In this case, the child's second utterance will be excluded from analyses.
   <u>Exception</u>: However, if the child uses the utterance or word provided by the author and further extend it, the utterance and word will be included in analyses. For example,
   *Child: How do you say mailbox?
   *Examiner: 信箱。(Mailbox.)
   *Child: 老人打開他的信箱。(The old man opened his mailbox.)
   In this case, the child's second utterance and the word 信箱 (mailbox) will be included in analyses.

3. Code-Switching
   a. If the entire utterance is spoken in English, the utterance will be excluded.
   b. If the child uses only use on English word, count the utterance but exclude the English word.
   c. If the entire utterance contains more than three English words, exclude the utterance.

Appendix H (Continued)

Guidelines for Mandarin Narrative Sample Transcription

Word Boundary

1. Aspect markers used to indicate action completion, duration, or repetition such as 過, 了, 著 will be counted as separate words.
2. Classifiers used to indicate the semantic category of a noun will be counted as separate words, for example, 一"朵"花 (one flower), 一"個"老人 (one old man), 一"張"紙 (one piece of paper), etc.
3. The Pronoun "們" used to indicate the plural form of nouns will be counted a separate word, for example, 媽媽"們" (mothers), 我"們" (we), 他"們" (they), etc.
4. Sentence final particles used to indicate a question or to improve the flow of speech will be counted separately, for example, 嗎 and 阿.

Appendix I

English Title Recognition Test

1. A light in the Attic
2. <u>Curious Jim</u>
3. How to Eat Fried Worms
4. Call of the Wild
5. The Chosen
6. <u>Joanne</u>
7. Tales of a Fourth Grade Nothing
8. The Polar Express
9. The Indian in the Cupboard
10. The Cybil War
11. <u>He's Your Little Brother!</u>
12. Homer Price
13. <u>It's My Room</u>
14. Heidi
15. <u>The Lost Shoe</u>
16. Freedom Train
17. <u>Hot Top</u>
18. <u>Skateboard</u>
19. James and the Giant Peach
20. By the Shores of Silver Lake
21. <u>Ethan Allen</u>
22. Superfudge
23. Dr. Dolittle
24. From the Mixed-Up Files of Mrs. Basil E. Frankweiler
25. Island of the Blue Dolphins
26. <u>Don't Go Away</u>
27. Ramona the Pest
28. Iggie's House
29. The Great Brain
30. <u>The Hideaway</u>
31. Misty of Chincoteague
32. Henry and the Clubhouse
33. Dear Mr. Henshaw
34. <u>The Missing Letter</u>
35. <u>The Rollaway</u>
36. Harriet the Spy
37. The Lion, the Witch and the Wardrobe
38. <u>Sadie Goes to Hollywood</u>
39. <u>The Schoolhouse</u>
40. Arthur's Tooth
41. Arthur's Baby
42. Best Friends for Frances
43. Bread and Jam for Frances
44. Amelia Bedelia
45. Corduroy
46. Curious George
47. Frederick
48. Frog and Toad are Friends
49. Harry the Dirty Dog
50. If you Give a Mouse a Cookie
51. IRA Sleeps Over
52. Little Bear
53. Millions of Cats
54. The Stupids Step Out
55. Sylvester and the Magic Pebble
56. The Very Hungry Caterpillar
57. Where the Wild Things Are
58. Puss in Boots
59. The Tale of Peter Rabbit

Note. Foil items are underlined.
Items 1 to 39 are the titles of chapter books adapted from Cunningham and Stanovich's study (1991).
Items 40 to 59 are the titles of picture books selected from *The New Read-Aloud Handbook* (Trelease, 1989)